

Brain Tumor Research Studentship
Final Report
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The purpose of this project was to evaluate the possibility of treating brain tumors with a natural extract from long pepper (LPE), by testing its effects on cells derived from brain tumors (glioblastoma cells), as well as their healthy counterpart (normal human astrocytes).

Initial studies have indicated that LPE effectively reduces the metabolic viability of glioblastoma cells at low doses in a dose dependent manner; this result was consistently observed in different long pepper products obtained from different sources. My initial results prompted further studies into how LPE works in glioblastoma cells. My work shows that LPE-treated glioblastoma cells exhibit signs of early programmed cell death type I (or apoptosis). Using fluorescence microscopy to assess the role of the mitochondria in the induction of apoptosis, it was observed that there was clear destabilization of the mitochondria for the release of pro-apoptotic factors in the glioblastoma cells treated with LPEs. Subsequent to the destabilization of the mitochondria, we observed that there was a high production of reactive oxygen species (ROS), following treatment with LPEs. This indicates that oxidative stress may play a role in the cell death mechanism. Western Blot analysis was used to confirm the efficacy of LPE in programmed cell death induction. I observed that the expression of several proteins that are involved in the cell survival and death mechanisms (such as Bcl-2, SOD-2, SQSTM-1, and TRAIL) are responding to the mitochondrial destabilization and oxidative stress induced by LPE treatments. However, further experimentation is essential to better understand the downstream effects of these proteins, once expression is induced.

Although these results are very exciting, there is always room for more work to be done. As discussed above, LPEs can induce the production of ROS, destabilize the mitochondria, affect the oxidative stress response mechanism and induce cell death. Future studies will be essential to better understand the role of oxidative stress in the induction of cell death; studying the innate oxidative stress response mechanisms of cancer cells and attempting to exploit this for development of effective treatment options will be of great value. Some of my preliminary studies show that LPEs have a greater cell death inducing activity on glioblastoma cells, with minimal effects on the normal cell counterparts. Finally, the effectiveness of LPE in tumor bearing mice and its ability to cross the blood-brain barrier, as well as how it interacts within a biological environment needs to be established for glioblastoma models.

This research studentship has had a tremendous impact on me personally. Through this studentship I have had the opportunity to work in a state-of-the art biochemistry research laboratory at the University of Windsor that is deeply engrained in the field of Natural Health Products. I was able to work under the supervision of a well established professor and was mentored by several post-doctorate and graduate students, who unreluctantly shared with me their vast wealth of knowledge. Due to this project I was able to successfully complete my undergraduate thesis, write out a thesis report and present and defend my research in the form of an oral presentation at an Undergraduate Research Colloquim at the University of Windsor. I learned more than just laboratory protocols, I learned how to think like a scientist, I also learned the importance of patience when experiments don't go so smoothly and how to never give up because the field of research is driven by surprises. For all of these reasons and many more, I am forever grateful for this research studentship.

This upcoming August, I will begin Dental School at the University of Detroit Mercy School of Dentistry in Michigan, USA, and I definitely plan to continue pursuing research. In addition to learning technical, hands-on research skills throughout this studentship, I have learned about the brain, learned about tumours, learned about the complications of having brain tumours and all the other aspects of life that are implicated with brain tumours, including oral health care, especially when the treatment is administered orally. This research studentship has definitely opened my eyes towards a new research path that I can pursue in Dental School; oral health care for those undergoing cancer treatments, namely brain tumour treatments. The tenure of this studentship has been a valuable part of my life, one that I will cherish dearly as I pursue higher education and continue my commitment to the field of research.

The tenure of this brain tumour research studentship has proven to be a worthwhile experience. These promising results can set the stage for future brain tumor treatments that are safe and non-toxic to improve the quality of life of brain tumor patients. Each experiment, each result, brings us one step closer to bettering millions of lives that are suffering from the effects of brain tumors and their current treatments.