Designing Nanoparticles to Target Cancer Cells

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Funded by OURE

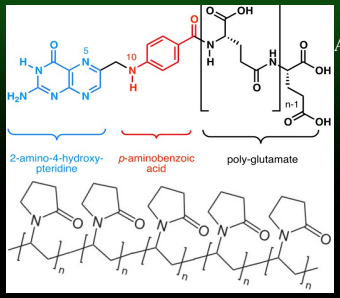

Figure 1, Wikipedia, FA and PVP

Introduction

- Nanoparticles offer a nonintrusive and cost-effective alternative to traditional cancer treatments.
- Through the use of biodegradable materials and radioactive isotopes with relatively short half-lives, these nanoparticles can be safely left in the body.
- The microscopic size of nanoparticles offers a unique advantage in that they can traverse throughout the body and target tumors directly, thus minimizing the damage to surrounding healthy cells.

Research Goals

- To develop a low-cost nanoparticle cancer treatment for certain breast and ovarian cancers.
- To further the field of nuclear medicine by exploring the greater use of radioactive nanoparticles in cancer treatments.

Approach

- A mixture of Polyvinylpyrrolidone (PVP) and Folic Acid (FA) is prepared. The FA serves as a "tracker" and the PVP serves as a "linker" between the "tracker" and the "payload", the radioactive nanoparticle. See Figure 1.
- UV-VIS spectroscopy is used to identify the concentration of FA within the mixture. See Figure 2.
- The PVP-FA mixture is bombarded with gamma and neutron radiation to crosslink the "tracker" to the "linker".
- The radioactive nanoparticle is produced through the use of the Missouri S&T Reactor (MSTR) and crosslinked to "tracker" and "linker". See Figure 3.

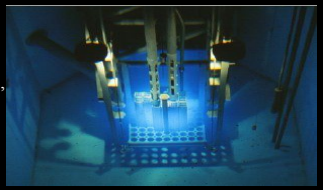

Figure 3, The MSTR's Core

Advantages Over Traditional Treatments

- Low risk of immune system rejection.
- In theory, less damage to surrounding cells compared to chemotherapy or traditional radiotherapy.
- Non-intrusive treatments allow for quick patient recovery.

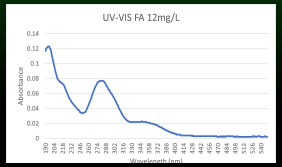

Figure 2, UV-VIS of FA

Shortcomings

- Significant studies need to be performed on tumor cultures, and eventually mice before human testing can be considered.
- The method of producing the PVP-FA link is still in its early stages and requires more development.
- Analysis of FA concentrations has been challenging with UV-VIS spectroscopy, and maintaining FA solubility in water has proved difficult.
- Creation of the crosslinked mixture and radioactive nanoparticle requires the use of an irradiation facility.

Conclusions and Outlook

- There is still much to be done before this method can be tested on live cancer cultures. More experimentation needs to be performed in the creation of the FA-PVP mixture before cross-linking tests can begin.
- The next step is to begin irradiation testing on the FA-PVP mixture.
- UV-VIS spectroscopy was initially unreliable as a method of measuring concentration, but this later solved to be an issue with the machine, and not a failure of the method.
- Dialysis is currently being used to test how FA interacts with PVP. In theory, the FA will become "entangled" in the PVP. This experiment is still in its early stages and needs to be completed before irradiation can be conducted. See Figure 4.

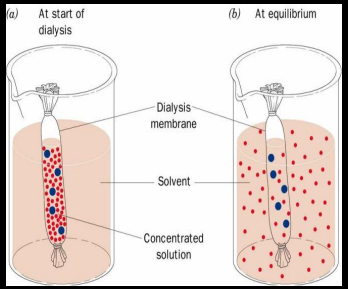

Figure 4, schoolworkhelper, Example of Dialysis Setup