Text Only

Tripti Singh

Title

Double Helical Nanotube Structures Can Be Used In Drug Delivery To **Target** Cancer Cells

By Tripti Singh

TRiO McNair Scholar

BS Candidate in Chemistry

CSU Stanislaus

Introduction

- **Oral chemotherapy** is the current preferred cancer treatment because it is the most efficient and doesn't have as many side effects as other cancer treatments
- However, anticancer drugs in chemotherapy have **poor efficacy** when it comes to targeting cancer cells[4], which greatly limits their applications in cancer treatment
- Thus, to improve the drug efficacy and avoid premature release of the anti-cancer drug before it reaches the targeted cancer cells, **targeted drug delivery systems** based on **nanomaterials** are now being explored
- Since most cancer cells have a more acidic environment compared to normal cells, an efficient way to control the drug release behavior is by using pH as a stimulus
- An experiment will be conducted using an oral drug delivery system in which **double helical nanotubes structures (DHNTS)** – a type of **mesoporous silica nanoparticle** (**MSN)** – will be encapsulated with doxorubicin hydrochloride (DOX), a well-known anticancer drug, which will then be released at specific pH level in the body to target cancer cells

What Are Mesoporous Silica Nanoparticles?

- MSN are composed of highly ordered mesoporous structures with uniform but adjustable pore size, ranging from pore sizes of 2 to 50 nm, which make it an excellent candidate to accommodate guest molecules such as drug molecules[2]
- They provide a physical encasement that can protect the entrapped drugs from degradation and denaturization[2]

Why double Helical Nanotube Structures?

- high surface areas[3]
- large pore volumes[3]
- adjustable pore size[3]
- high chemical and thermal stability[5]
- pore structures can control the drug loading and release processes[5]
- readily available at a significant scale using simple aqueous chemistry without the use of expensive templating systems[3]

Proposed Methodology

- DHNTS will be used to encapsulate DOX into the mesopores of DHNTS
- PAA will be chosen as the gatekeeper to block the pores due to its good biocompatibility, excellent water solubility and significant gating effect[4]
- Upon reaching a certain pH level in the body, PAA will collapse and DOX will be released, therefore stopping the growth of cancer cells.

Expected Results

We hypothesize that double helical nanotube structures will be used to target cancer cells in the body. The DHNTS will be encapsulated with DOX, a well-known anticancer drug, and DOX will then release at a specific pH level in the body.

References

1. *Cancer Statistics*. (2020, September 25). National Cancer Institute. https://www.cancer.gov/about-cancer/understanding/statistics

2. Yuan, L., Tang, Q., Yang, D., Zhang, J. Z., Zhang, F., & Hu, J. (2011). Preparation of pH-Responsive Mesoporous Silica Nanoparticles and Their Application in Controlled Drug Delivery. *The Journal of Physical Chemistry C*, *115*(20), 9926–9932. https://doi.org/10.1021/jp201053d

3. Beaton, L., Zhang, S., & Kruk, M. (2021). Formation of Double-Helical Structures by Silica Nanotubes Templated by Mixtures of Common Nonionic Surfactants in Aqueous Solutions. *ACS Nano*, *15*(1), 1016–1029. https://doi.org/10.1021/acsnano.0c07748

4. Tian, B., Liu, S., Wu, S., Lu, W., Wang, D., Jin, L., Hu, B., Li, K., Wang, Z., & Quan, Z. (2017). pH-responsive poly (acrylic acid)-gated mesoporous silica and its application in oral colon targeted drug delivery for doxorubicin. *Colloids and Surfaces B: Biointerfaces*, *154*, 287–296. https://doi.org/10.1016/j.colsurfb.2017.03.024

5. Sábio, R. M., Meneguin, A. B., Martins dos Santos, A., Monteiro, A. S., & Chorilli, M. (2021). Exploiting mesoporous silica nanoparticles as versatile drug carriers for several routes of administration. *Microporous and Mesoporous Materials*, *312*, 110774. https://doi.org/10.1016/j.micromeso.2020.110774