VKURA Internship Summer 2022 – Polymeric Nanoparticles for Drug Delivery: Exploring the Co-Encapsulation of SN-38 and Curcumin

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Introduction

- SN-38 is used in research as an anticancer treatment but has limited clinical uses due to factors including low water solubility, and the molecule's inactivity above a pH of 6.
- Polymer nanoparticles (PNPs) were used to encapsulate SN-38 in their hydrophobic cores.
- Curcumin/SN-38 co-loaded PNPs showed a higher encapsulation efficiency compared to SN-38 PNPs alone.[1]

Methods[1]

- PNPs were made by nanoprecipitation using a microfluidic reactor (see Figure 3. B). The microfluidic reactor used is two-phased (gas-liquid). Argon gas and fast mixing of water, solvent (*N,N*-dimethylformamide - DMF), SN-38, curcumin, and copolymer forms the co-loaded PNPs.
- Dialysis removes the solvent (DMF) via molecular porous membrane tubing in de-ionized water (see Figure 3. A).
- Dynamic light scattering (DLS) allows for particle sizing and polydispersity measurements.
- Rotary evaporation removes water from the samples. Acetonitrile is added to the dry samples, which are sonicated overnight. High-performance liquid chromatography (HPLC) is then performed to determine the SN-38 and curcumin concentrations.

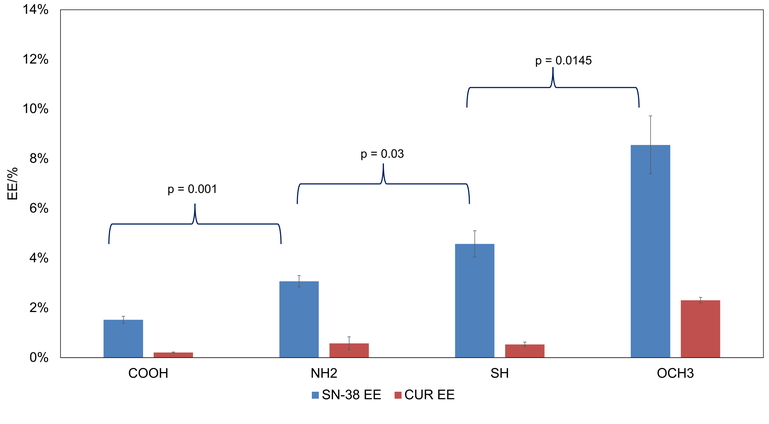
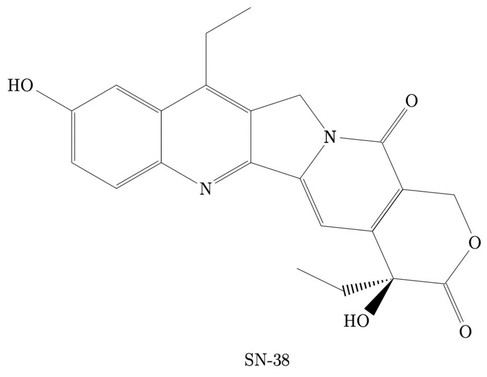
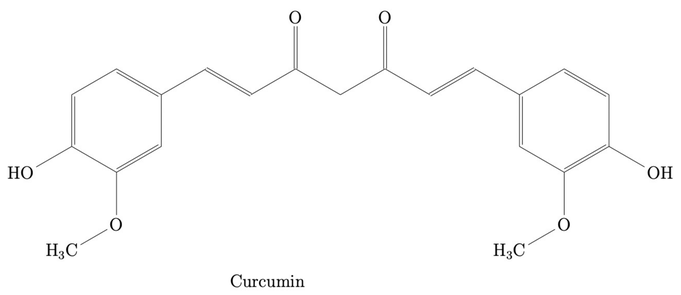


Figure 1. Encapsulation efficiency (EE) of SN-38 and curcumin (CUR) with polymers of differing functionalized end groups. Figure used with permission of author (Liza Silverman). Unpublished work.

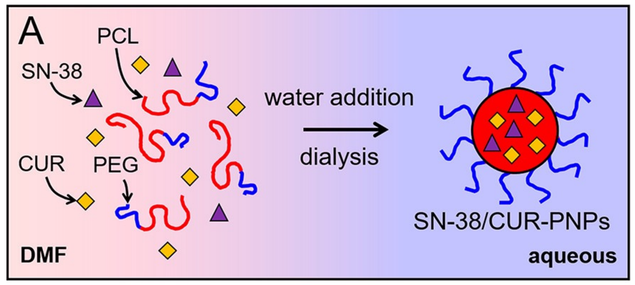


SN-38



Curcumin

Figure 2. SN-38 and curcumin molecular structures. Created with chemfig package on LaTeX. Amélie Cazelais, 2022.



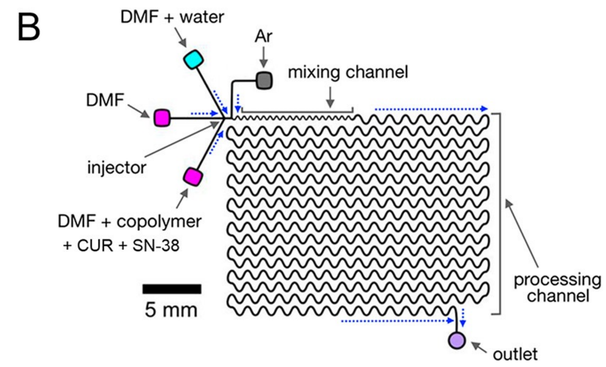


Figure 3. (A) Formation of PNPs co-loaded with SN-38 and curcumin. (B) Microfluidic reactor.[1]

Results and Conclusions

- The polymer poly(ε- caprolactone)-*b*-poly(ethylene glycol) (PCL-*b*-PEG) was used to create PNPs. Different functionalized end groups were analyzed this summer, including the carboxyl (COOH), amine (NH_2), and thiol (SH) functional groups.
- A possible trend was observed regarding polarity and encapsulation efficiency of SN-38 (see Figure 1.) – the least polar functionalized end groups on the polymer had higher encapsulation efficiencies.
- Another less polar polymer will be created by Dr. Chuanqi Zhao of the Manners Group in order to observe the possibility of a trend.
- PNPs are a promising route leading to further clinical uses of SN-38 in cancer treatment.

Acknowledgments

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References

1. Improvements in Drug-Delivery Properties by Co-Encapsulating Curcumin in SN-38-Loaded Anticancer Polymeric Nanoparticles. Lisa Silverman, Gitika Bhatti, Jeremy E. Wulff, and Matthew G. Moffitt. *Molecular Pharmaceutics* **2022** *19* (6), 1866-1881. DOI: 10.1021/acs.molpharmaceut.2c00005