CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

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Project Number

38713

Project Title

Cell-Free Protein Synthesis Derived Hepatitis B Core Virus-Like Particles: Designing a Thermostable Therapeutic Scaffold

Abstract

Objectives/Goals

Cold-chain methods and unsanitary conditions hinder vaccine transport in third-world countries. Climate detrimentally affects vaccine potency, and, without an efficient alternative, organizations are forced to invest thousands of dollars on specialized vehicles, cold boxes, and auxiliary items. Vaccines are mishandled, resulting in the costly disposal of unused vaccinations. Additionally, accidental reuse of syringes can lead to contamination. This project studied the temperature stability of virus-like particles with different ligands post flash freezing to improve vaccine potency and sanitation under extreme conditions.

Methods/Materials

After production by cell-free protein synthesis, purification by desalting columns, and assembly by salt spike, the VLPs were flash frozen/thawed three times in liquid nitrogen. Then, the assemblage efficiency was measured to compare fresh to flash-frozen VLPs by using nickel size exclusion columns.

Results

The data suggested that polyhistidine VLPs exhibited a post-thaw assembly yield of 87.63% and a fresh assembly yield of 69.39%. The fresh and freeze-thaw curves exhibited a correlation coefficient of 0.9989. More polyhistidine VLPs were produced after freeze-thawing, and the protein structure was not affected by the freeze-thaw.

Conclusions/Discussion

As a result, VLPs are thermostable and can have retained potency through lyophilization. Even though the data for the other VLPs exhibited similar trends, the hydrophobicity of those extensions provided inconclusive size-exclusion column data. Thus, future experimentation will not only include animal testing of lyophilized VLPs, but also will include retesting the VLP assemblage with other size exclusion technologies. Through the use of an air-jet gun injector instead of a syringe to inject lyophilized VLPs, the risk of contamination can be eradicated. VLPs can eliminate the need for cold chain transport, and, through #click-chemistry# appended ligands, biotechnology companies can also use thermostable core VLPs to efficiently engineer new vaccines as per emerging outbreaks.

Summary Statement

I discovered that Hepatitis B core virus-like particles are thermoresistant and can be applied in thermostable therapeutics.

Help Received

My mentor, Julie Fogarty, helped me learn all of the wet lab techniques and learn how to analyze the data results.