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2014 REU Poster: Quantifying Lipid Contents In Liposomes with Enveloped Plasmonic Nanoparticles

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I. Abstract
Phosphatidylserine (PS) and monosialotetrahexosylganglioside (GM1) are examples of two host-derived lipids in the membrane of enveloped virus particles that are known to contribute to virus attachment, uptake, and ultimately dissemination. We learn the binding affinity of PS and GM1 by using gold nanoparticle (GNP) since it is stable and conductive. Besides, changing concentration of lipid on the virus can control how the virus infective. The performed studies can use identify unknown concentration of lipid.

II. Introduction

1. Plasmonic nanoparticle

Applying light to plasmonic nanoparticle, it generates electromagnetic field. Therefore, it causes the electrons are moving back and forth. Those oscillation electrons (plasmons) give strong scattering cross section in resonance wavelength. In a situation where two plasmons are nearby, they can interact with one another. It is shown on spectrum as a red-shift, as seen in figure 2.

2. Virus Like Particle (VLP) and Liposomes

In VLP and Liposomes, there are two kind of lipids (PS and GM1) that are playing important role in infectivity. Phosphatidylserine(PS) has been shown to facilitate apoptotic mimicry and enhance glycoprotein-independent uptake of Vaccinia, Ebola, HIV, and Dengue viruses. Monosialotetrahexosylganglioside (GM1) enable the glycoprotein-independent binding of HIV-1 particles to mature dendritic cells (mDCs).

III. Experimental Procedure

1. Liposomes-PS and Liposomes-GM1

PS in the liposome membrane are functionalized with biotinylated Annexin V (Anx). On the other hand, liposome membrane with GM1 lipid are functionalized with cholera toxin subunit B (CTB). Then, neutravidin is added to the solution. After neutravidin binds to the PS or GM1, the solutions are purified though dialysis for 48 hours.

2. 40 nm Gold Nanoparticle

Gold nanoparticles are prepared by adding single stranded DNA oligonucleotides HS-AAAAAfredGCTAC-GACTGAC ACC and HS-AAAAGCCCTACTAAAGACCTACTAAC AACCAGAGA-Biotin in a 4:1 ratio to 40 nm GNP. After sitting 30 min to allow DNA stick to the GNP, these particles are centrifuged for three times.

IV. Data/Results

1. Optical Measurement

Based on the UV-Vis spectra, GM1 binding of GNPs show a higher affinity than PS binding. Using this assay, we get up to 3 nm red-shift in case of 20%PS and up to 6 nm for 10%GM1 liposomes. The Reinhard lab plans to continue to research this and applying it on virus-like particles with unknown lipid compositions.

V. Conclusions/Future Work

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VII. References