CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Aryo Sorayya

Project Number
S0529

Project Title
Overcoming the Cold Chain: Designing a Novel Freeze-Stable Vaccine

Abstract

Objectives/Goals

To design a novel vaccine that does not lose its potency upon freezing as an alternative to freeze-sensitive aluminum-based vaccines.

A lipid blend-complex made of natural, biodegradable lipids might be a good alternative to Aluminum-based adjuvants. If the antigen-lipid blend complex withstands freeze-drying (lyophilization) without loss of activity, it will also be stable after freezing because during freeze-drying the vaccine will be frozen at -45 oC.

Methods/Materials

The immunogenicity of two liposomal vaccine formulations (liquid and lyophilized) was compared to that of an Aluminum phosphate (Adju-Phos) based vaccine using chicken egg Lysozyme as a model protein. The Lysozyme was entrapped in liposomes and adsorbed to Adju-Phos. As control, Lysozyme solution in 10% sucrose without adjuvant was used. Concentrations of entrapped and unbound Lysozyme were measured using UV Spectrophotometry with each measurement repeated three times.

Each formulation was injected into four mice (i.e. 16 mice total) intramuscularly on days 0 and 14. Blood was collected on Day 28. The mouse antibody response to each vaccine was measured in diluted sera of immunized and non-immunized mice by an Indirect ELISA method. The concentration of antibody in each mouse was measured twice at eight different dilutions.

Results

Both liquid and lyophilized liposomal vaccines gave a significant 3-6-fold immunogenic response greater than that of the Lysozyme solution without adjuvant. The lyophilized liposomes appeared to be slightly better (around 2 fold) than the liquid non-lyophilized liposomes. Adju-Phos Lysozyme vaccine had the highest immune response that was 9-fold more than the Lysozyme solution. Statistically, the lyophilized liposomes and Adju-Phos had similar immune responses.

Conclusions/Discussion

Using a natural lipid composite as an adjuvant, it was possible to manufacture a vaccine with entrapped protein antigen that had a significant immunogenic response in mice. This natural lipid composite did not lose its immunogenic activity upon lyophilization and might thus be used as a freeze-stable vaccine as an alternative to Aluminum salt adjuvants.

Summary Statement

A novel freeze-stable vaccine with potent immunogenic IgG induction in mice similar to that of Aluminum-based vaccines was successfully designed and tested in vivo.

Help Received

Used lab equipment at HTD Biosystems under the supervision of Dr. Rajiv Nayar; Mice immunization was conducted at Pacific Biolabs