Spray Drying Adjuvanted Tuberculosis Vaccine Encapsulates Nano-emulsions Within a Dry Powder Inhalable Product

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Introduction

- ID93+GLA-SE is a subunit vaccine developed by the Infectious Disease Research Institute (IDRI) to induce immunity against TB
  - The vaccine is a **nano-emulsion** where the **antigen** (ID93) is associated with the **adjuvant** emulsion droplets (**GLA-SE**)
  - **Liquid injectable** presentation is currently undergoing **Phase II clinical trials** [1]

- Why move to a dry powder inhalable product?
  - Eliminate the **cold-chain** requirement
  - Reduce risks associated with **needles**
  - Respiratory vaccination may also be **more efficacious** for respirable diseases [2]

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A successful spray dried inhalable vaccine product must have several characteristics:

1. The microparticles must encapsulate the **nano-emulsion** droplets with a **high retention rate**

2. The microparticles must **stabilize** the **biologic components** ID93 and GLA at **room temperature**

3. The primary particle size must be within an **inhalable range** (MMAD 2-5 µm)

4. The dry powder must be **easily dispersible**
Spray drying vaccine with trehalose encapsulates the nano-emulsion droplets within an amorphous trehalose matrix, addition of trileucine as a dispersibility enhancer to the formulation generates rugose particles.
Comparison of chemical properties of the liquid vaccine to reconstituted spray dried powder show that vaccine integrity is preserved.
Produced powders are compatible with dry powder delivery

- Aerosol performance of powders was tested by stimulating inhalation through a dry powder inhaler
- Definitions:
  - Emitted Dose: % of dose emitted from low-resistance DPI
  - Total Lung Dose: % of dose past mouth-throat
  - Fine Particle Fraction: % of dose <5 µm

Results shown are the average of triplicates, standard deviation is represented as error bars.

Conclusions

- Spray drying encapsulates an adjuvanted tuberculosis vaccine within an inhalable dry powder product
  - **Nano-emulsions** can be spray dried into a dry powder with **high encapsulation efficiency**
  - **Actives are stabilized** within an amorphous glass matrix
  - Resulting powder with **dispersibility enhancer** has **reasonable aerosol performance**

[Images of liquid feedstock, spray dried powder, and reconstituted formulation]
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