

## NRC Institute for Biological Sciences (NRC-IBS)

### Business Opportunity:

# ***Synthetic Ether Lipid (Archaeosome) delivery/adjuvant technology***

### **The Business Opportunity**

Adjuvants play a central role in vaccination and are defined as formulated compounds or additives that, when combined with vaccine antigens, help to direct or boost the body's immune response. That is, they can enhance the magnitude, the quality and the duration of immune responses. As a result of their increased potency, vaccines containing adjuvants can produce greater vaccine protection within a shorter treatment time. Adjuvants can be classified in two main categories: "immuno-modulators" which bolster the innate immune system, in turn directing vaccine-specific immunity, and "antigen delivery systems" which deliver the antigen to the right immune cells.

The vaccine market is highly concentrated in that a handful of pharma companies' account for more than 80% of sales worldwide. These pharmas and an increasing number of biotech firms are developing new vaccines on the basis of defined antigens, primarily with a view to treating cancer and emerging and re-emerging infectious disease. However, all these developers lack non-toxic adjuvants. Alum is the leading approved adjuvant for human use, and yet it fails to facilitate strong cell-mediated immune responses. Also, no single strategy dually targets both vaccine delivery and immunomodulation. Adjuvant formulations that can promote long-term immunity with few injections and yet evoke minimal inflammatory side effects have great value for widespread commercial use.

### **The Technology**

Subunit vaccines capable of providing protective immunity against the intracellular pathogens and cancers that kill millions of people annually require an adjuvant capable of directing a sufficiently potent cytotoxic T lymphocyte response to purified antigens, without toxicity issues. Archaeosome lipid vesicles, prepared from isoprenoid lipids extracted from archaea, are one such adjuvant in development. Archaeosomes have both immuno-modulator and antigen-delivery adjuvant properties.

In this newest technology, the stability of an archaeal core lipid (archaeol) is used as the lipid precursor to synthesize a series of glyco-archaeols and phospho-archaeols to prepare lipid vesicle carrier/adjuvant systems. In this way archaeal synthetic lipid mimetics, not limited to those found naturally in *Archaea*, are screened to optimize the carrier/adjuvant effect desired.

Our synthetic approach was to first obtain the archaeol lipid core from *Halobacterium salinarum*, chosen because this easily grown archaeon has only one core lipid, namely, fully-saturated archaeol. Upon head group removal the mixture of natural polar lipids is converted to archaeol that is easily recovered in high yields and serves as a chemically stable precursor for synthesis. This approach preserves all of the desired archaeal lipid features. All processes used are readily scalable to industrial quantities and pharmaceutical purities.

Synthetic archaeal lipids are mixed in the proportion desired and hydrated to form 100-nm diameter vesicles with the active ingredient attached or entrapped within the vesicles. Mouse trials have shown strong antibody and cytotoxic T lymphocyte responses to peptide and protein antigens and protection in model systems of infection and cancer.

This technology provides an easy-to-apply synthetic approach for deriving well-defined, tailor-made adjuvants that can evoke specific responses as appropriate for each chosen application.

### **Key Publications**

Sprott, G.D., Dicaire, C.J., Cote, J.-P., and Whitfield, D.M. (2008) Adjuvant potential of archaeal glycolipid mimetics critically depends on the glyco head group structure. *Glycobiology* *In press*

Whitfield, D.W., Eichler, E.E., and Sprott, G.D. (2008) Synthesis of archaeal glycolipid adjuvants – What is the optimal number of sugars? *In review*

### **Patent position**

NRC IBS case 11784

### **The Market**

Adjuvants have a very broad range of potential applications and relate to the vast majority of vaccines in development. The vaccine market is estimated to reach more than \$18 billion by 2015.

### **Technology transfer possibilities**

- A commercial exploitation license for synthetic archaeosomes applications.
- Development through a joint collaboration with NRC for vaccine/or drug delivery applications.

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