MicroCube technology vaccine platform

Opportunity

Despite an unprecedented research effort, there is still no vaccine against HIV. Versatile platforms such as DNA vaccines or recombinant viruses have been investigated over the past decade without fully fulfilling their initial promises.

MicroCubes are protein-based vaccines that are also able to accommodate various antigens and to elicit strong T-cell responses. They distinguish themselves by the unique crystalline organisation, resulting in slow-release of the antigen and self-adjuvanted stimulation of both arms of the immune system.

Background

Traditionally, antiviral vaccines have been developed from attenuated or killed viruses because they induce superior responses especially as far as T-cell responses are concerned. Unfortunately, this method of vaccination could only be extended to few of the pathogens afflicting humanity and may be associated with significant side effects.

Over the years, many alternative antigen delivery systems have been actively investigated for greater efficacy, safety and ease of production. One of the most successful of these approaches has been the use of virus-like particles relying on self-assembly of viral structural proteins. This is the basis of recent successes such as the anti-HBV vaccine, the anti-human papillomavirus vaccine or the RTS,S malaria vaccine candidate.

However many pathogens do not produce such assemblies and there are limitations to the size of the antigens that can be incorporated onto heterologous VLP scaffolds.

Thus, there is a need for a versatile vaccine platform able to deliver antigens of various nature and size and inducing robust humoral and cellular responses.

Market

HIV Vaccine

Patent status

Patent Application No. PCT/AU2011/000763

Advantages

- **Versatility:** Owing to their natural packing function, MicroCubes have the advantage of tolerating virtually any antigen or combination of antigens.
- **Stability:** MicroCubes are highly heat and protease-resistant, allowing conservation at room temperature without the need for refrigeration.
- **Slow-release:** The outstanding stability of MicroCubes means that they only slowly dissolve to release the antigen generating a sustained stimulation of the immune system.
- **Self-adjuvanted:** The crystalline nature of MicroCubes results in activation of both arms of the immune system with strong humoral and T-cell responses.

Potential products and applications

The ease of design and versatility of MicroCubes supports their use as a potential generic platform for vaccines against infectious diseases, cancer and other undesirable conditions.

The superior stability of MicroCubes suggests that they will be particularly studied in cases where the cold chain is too expensive or unpractical to maintain.

Technology

MicroCubes were developed from protein crystals called polyhedra produced by common insect viruses. In nature, these crystals function to protect the virus particles and are thus robust and able to package large protein cargoes.

We engineered MicroCubes to incorporate antigens of interest in place of the virus particles thereby exploiting their remarkable robustness and multivalent presentation of antigens. Importantly, their capacity to accommodate cargoes of different sizes and natures is unique and vastly superior to that of traditional virus-like particles.

Recent murine immunisation studies showed no toxic effect of MicroCubes and demonstrated that HIV Gag MicroCubes induce robust Gag-specific humoral and cellular responses.

Key researchers

Dr Fasseli Coulibaly

Dr Fasseli Coulibaly is the head of the Structural Virology Group within the Faculty of Medicine, Nursing and Health Sciences.

Dr Fasseli Coulibaly holds a PhD in protein crystallography from the University of Paris-Sud (2003) supervised by Dr Felix Rey (CNRS Pasteur Institute). He then undertook four years of post-doctoral training at the University of Auckland, New Zealand (2004-2008) in the laboratory of Professor Ted Baker to pursue his structural studies of viral and bacterial proteins involved in virulence.

In 2008, he moved to Australia to take up a senior research fellow position at Monash to establish an independent research group focused on Structural Virology and won an NHMRC (National Health and Medical Research Council) Career Development Fellowship (2009-2012).

Dr Coulibaly's long-term interest in Structural Virology produced paradigm shifts in the evolution of viruses (Cell, 05 and PNAS, 09), microcrystallography breakthroughs (Nature, 07) and discovery of novel stabilising strategies in bacterial virulence factors (Science 2007).

He is co-inventor on three patents protecting the applications of findings on flaviviruses, cypovirus polyhedra and microcrystalline vaccines. His research is funded by national (NHMRC and ARC) and international (Gates Foundation) – competitive grants.

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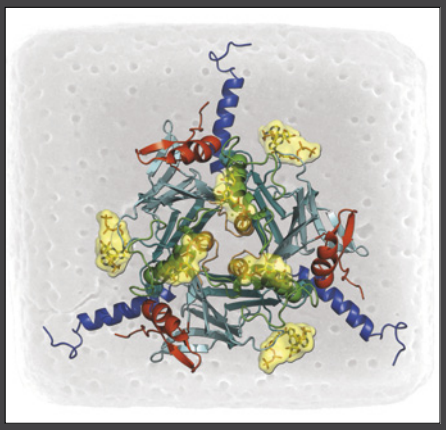

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