Cool crystals and hot climates

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A crystalline structure used by a silkworm virus to protect itself from the elements may provide similar protection for human vaccines in challenging tropical climates and remote regions.

One of problems facing health officials trying to supply, and use, vaccines in remote regions where refrigeration is either limited, unreliable or non-existent is that vital vaccines are sensitive to hot conditions.

A possible life-saving solution comes in the unlikely form of a crystalline "life raft" built by a silkworm virus to protect its viral "weaponry" from the elements. This pathogenic material is embedded into the protein crystal that, like an armoured safe, protects it (in the soil or on leaves) until a silkworm ingests the crystal and provides the virus with a new host.

Monash University's Dr Fasséli Coulibaly discovered this structure, which is a crystal formed from a single protein, in 2007 in collaboration with Associate Professor Peter Metcalf from the University of Auckland. Having mapped the crystal using X-ray crystallography – in itself a groundbreaking endeavour – Dr Coulibaly set out to explore what might be done with this discovery.

Given the MicroCubes' ability to protect against extremes of temperature, one of Dr Coulibaly's first thoughts was their application in hot climates.

"Some of my family is from Mali in West Africa, where infectious diseases are a serious problem that contributes to a very low life expectancy," he said.

Dr Coulibaly says the research has given him a welcome opportunity to have some direct, positive impact on public health. With funding from the Bill and Melinda Gates Foundation's Grand Challenges Explorations program, and in partnership with co-researchers Dr Rosemary Ffrench from the Monash Department of Immunology and the Burnet Institute, and the University of Melbourne's Professor Lorena Brown, Dr Coulibaly has set out to develop the MicroCubes as a vaccine delivery method for a range of diseases, including HIV and influenza.

The MicroCubes are also relatively easy to synthesise compared with conventional vaccines, offering further advantages for vaccine production in developing countries.

Their crystalline structure sets them apart from other vaccines, and also means they act in different ways. They are able to mimic the surface of viruses by presenting a regular array of selected viral components, and for this reason he expects them to prove particularly effective. They may even, he says, enable the development of vaccines that currently do not exist – for HIV or malaria, for example, or a universal flu vaccine.

Provided by Monash University