Nano-Encapsidation Technology of Candidate DNA Vaccines

Using the HPV envelope as a non-replicating capsid as a delivery vehicle for DNA vaccines

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Background

Currently, naked nucleic acid vaccines are used as genetic vaccination candidates. Naked nucleic acid vaccines have generally shown lower immunogenicity in patients. An emerging mode of delivery for DNA therapeutics is the employment of non-replicative viral particles, or pseudovirions (PSVs). PSVs mimic a viral capsid to facilitate the delivery of the gene.

Currently, PSVs are only made in cancer-derived, cultured mammalian cells by transfection of purified DNA. This introduces a risk that PSVs could possibly encapsidate oncogenes (cancer-causing genes) from the cell lines, or could be contaminated by mammalian viruses. Our technology obviates this concern.

UCT researchers have developed an alternative production method for Human Papilloma Virus (HPV) pseudovirion (PSV) using plant expression systems. The resultant production is scalable, cost-effective and reduces the risk of transferring genetic material to the expressed product.

Technology Overview

The application of the HPV PSV as a DNA therapeutic delivery vehicle could be used as a vaccine delivery vehicle against cutaneous HPV and other diseases.

HPV is common in cutaneous tissues and hence they are also indicated in other cancers such as skin, throat and lung cancer. Thus the HPV PSVs would have application in the treatment of most if not all cutaneous cancers.

HPV PSV has been confirmed to deliver DNA into dendritic cells of patients to trigger cytotoxic T-cell immunity. This would mean that all infections presenting antigens in the blood could potentially be targeted.

Another application of HPV PSV is in affordable candidate vaccine development and, in particular, inexpensive testing of immune sera. PSV-based neutralization assay (PBNA), is currently the gold standard for testing candidate HPV vaccines.

HPV PSVs, therefore, have commercial value either as a stand-alone product or as a commercial neutralization kit, which could be sold to companies or to individual researchers to test their candidate HPV vaccines.

Our invention includes the luciferase reporter gene, which makes the assay simpler and cheaper compared to the conventional SEAP assay.

Benefits

- Pseudovirion expression in plants is a highly scalable process
- Recombinant protein expression in plants is a highly scalable process
- Plant-based expression removes the possibility of oncogene or mammalian virus contamination because the plant virus-derived DNA that is encapsidated in the particles has no possibility of replicating in normal mammalian cells, or of recombining with other mammalian viruses or transposon-like sequences

Proof of concept was demonstrated with the successful encapsidation of candidate breast cancer vaccines, and then the successful delivery of these to target cancer cells (Hek293TT and C3 cells).

There are no HPV genes that accompany this product, however, the PSV mimic the HPV infection.

Further Details

Technology Readiness Level 5 - Early Prototype

Applications

The candidate PSVs could act as a carrier for your nucleic acid candidates. It is also possible for the PSVs to act as a therapeutic HPV vaccine candidate that elicits an immune response. This construct could therefore be ideal for cervical cancer candidates.

Opportunity

The stage of development for this technology is at preliminary in-vitro pre-clinical trial and testing.

UCT is looking for potential licensees who either;

- have validated nucleic acid-based candidate cancer vaccines that they would like to encapsidate in our PSVs to demonstrate the delivery of their vaccines, or
- a company with established plant expression systems, who would benefit from being able to offer the candidate PSVs to their own clients

UCT would like to license the technology to partners who fit the opportunity.

Patents

- South Africa: 2016/00098 (Granted)
- USA: 14/907,323 (Granted)
- Canada: 2,918,158
- Europe: 14776902.0

IP Status

- Patent application submitted

Seeking

- Development partner
- Seeking investment
- Licensing
- Commercial partner