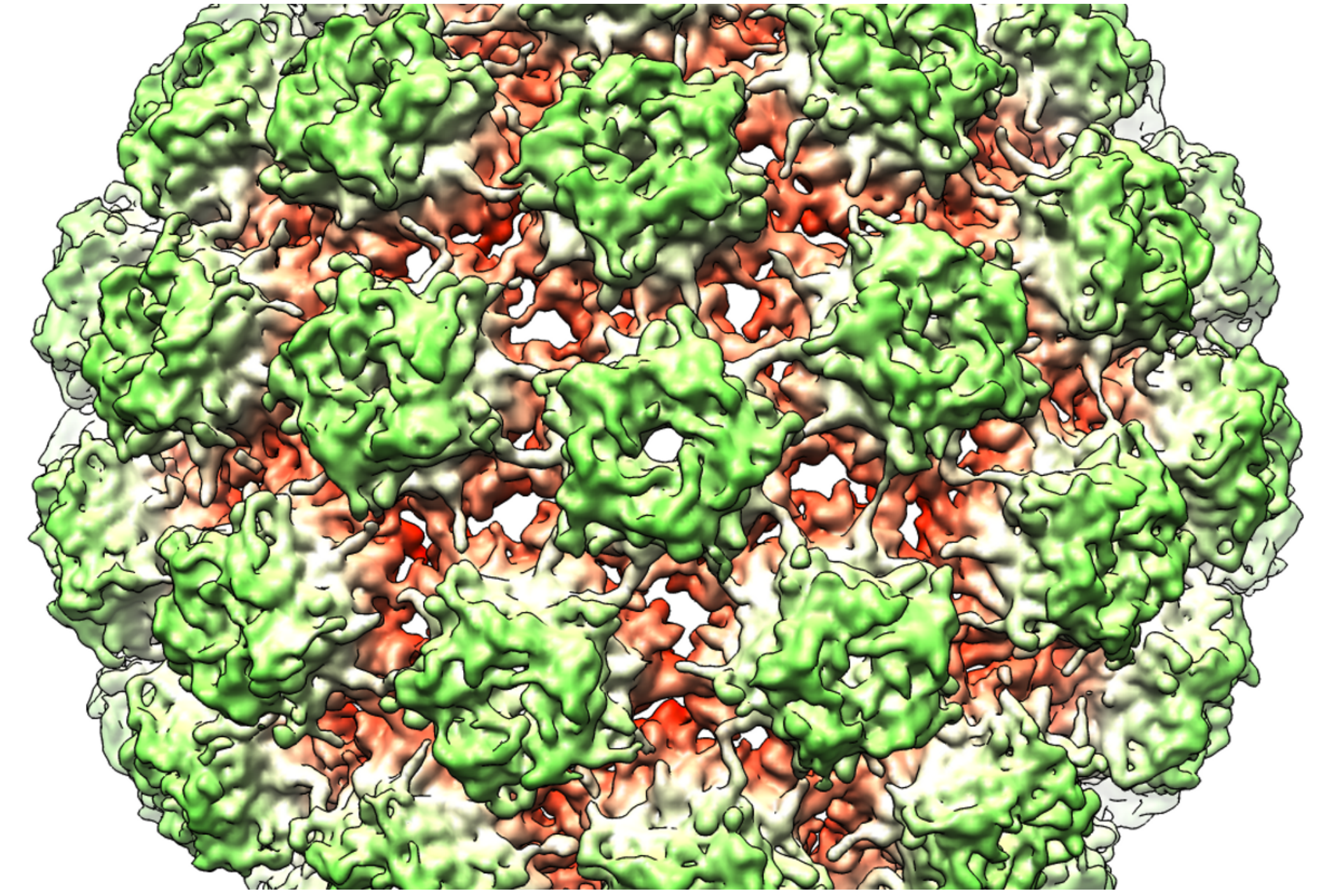
Animal Vaccine Encapsidation Technology

Plant produced Bovine papillomaviruses (BPV) pseudovirions capable of nano-encapsidation of dsDNA vaccine

Published: 27th February 2023



Vossman, CC BY-SA 3.0 https://commons.wikimedia.org/wiki/File:Bovine_Papillomavirus_Capsid.png

Background

Bovine papillomaviruses (BPVs) are DNA viruses that have been implicated in several diseases and cancers of considerable veterinary and agricultural importance in cattle, horses, as well as several wild animal species. The disease affects the animal's ability to function and their appearance.

As BPV is widespread, easily transmissible, and infection often occurs asymptomatically, it is imperative that interventions are carried out to mitigate the threat of outbreaks occurring in livestock.

There is a demand for prophylactic vaccines to immunize animals routinely and from a young age so as to prevent infection from occurring, as there is currently no fully effective treatment against established disease. Virus-like particles (VLPs) have in recent years been adopted as safe and efficacious vaccine antigens, and pseudovirions (PsVs) as experimental vaccines and vectors for therapeutic agents. VLPs mimic the native virus but contain no viral DNA and combine the advantages of whole-virus vaccines and recombinant subunit vaccines, such as: the preservation of native antigenic conformations; high safety based on the fact that VLPs are non-replicative, non-pathogenic, and non-infectious; a high level of stability; and an ability to Differentiate Infected from Vaccinated Animals (DIVA), making them DIVA-compliant.

Plant-based expression systems for the production of biopharmaceuticals such as VLPs and pseudovirions, offer several advantages over traditional protein expression systems, chief of which is a reduction in production costs, improved biosafety features, and a potential for rapid scalability.

Researchers at the University of Cape Town have demonstrated the nano-encapsidation of non-native DNA in plant-expressed and assembled BPV1 VLPs and pseudo-viruses. The pseudo-viruses could be used as DNA vaccine delivery vehicles for animal, especially cattle, vaccines and other payloads. Similarly, the researchers are capable of modifying the tobacco mosaic virus to encapsidate single-stranded RNA.

Technology Overview

The University of Cape Town have demonstrated the plant expression of BPV VLPs that have assembled into pseudovirions in *N. benthamiana* and the extraction thereof.

BPV pseudovirions can encapsidate double-stranded DNA vaccine candidates of approximately 4 to 8 kDa in size.

BPV has served as a model for papilloma virus vaccine development both for BPV and for Human papillomavirus-induced cancers. L1 and L2 Virus-like particles (VLPs) are known to act as a prophylactic vaccine; and BPV-4 E7 or BPV-2 L2 could be used as therapeutic vaccines.

The inventors have encapsidated target double stranded DNA with the intention of using the BPV pseudovirions as a DNA vaccine delivery vehicle.

Benefits

A bovine papillomavirus (BPV) pseudovirion expressed in plants could have several potential benefits, including:

1. **Improved vaccine production**: BPV pseudovirions can be used as a vaccine for preventing bovine papillomavirus-induced tumors in cattle. Producing BPV pseudovirions in plants could provide a low-cost and scalable method for vaccine production, as well as reducing the need for animal-derived components in the production process.
2. **Research applications**: BPV pseudovirions expressed in plants could be used as a research tool to study the viral life cycle, host-virus interactions, and the immune response to BPV infection.
3. **Gene delivery**: BPV pseudovirions can be used as a vehicle for delivering therapeutic genes to target cells, including cancer cells. Producing BPV pseudovirions in plants could provide a low-cost and scalable method for gene delivery.

These potential benefits are currently under investigation and further research is needed to fully understand their potential and limitations.

Applications

Bovine papillomavirus (BPV) pseudovirions mimic the structure and properties of naturally occurring BPV virions. These pseudovirions have a number of potential applications in various fields, including:

1. **Virology research**: BPV pseudovirions can be used as research tools to study the viral life cycle, host-virus interactions, and the mechanisms of viral entry and replication.
2. **Gene delivery**: BPV pseudovirions can be used as a delivery vehicle for therapeutic genes in gene therapy applications.
3. **Biotechnology**: BPV pseudovirions can be used as a platform for the development of new diagnostic tests and biosensors.

BPV pseudovirions offer a versatile and cost-effective tool for studying various aspects of virology, cell biology, and biotechnology.

Opportunity

The University of Cape Town is seeking funders, researchers and/ or a pharmaceutical companies that may be interested in the DNA delivery and nano-encapsidation properties of the plant-produced BPV pseudovirions.

The technology is at a proof-of-concept stage for the formation of the plant expressed pseudovirions and at a pre-proof-of-concept stage for the nano-encapsidation and delivery stages of DNA vaccine payloads.

The researchers would be interested in joint funding applications with research collaboration partners to further the development of this and related technologies.

Patents

- "Plant Produced Bovine Papillomavirus Virus-Like Particles and Pseudovirions" South African provisional patent application number 2020/00826
- "Plant Produced Bovine Papillomavirus Virus-Like Particles and Pseudovirions" United Kingdom Patent application number 2013703.0
- "Plant Produced Bovine Papillomavirus Virus-Like Particles and Pseudovirions" PCT application PCT/IB2021/051063

IP Status

- Provisional patent
- Patent application submitted
- Know-how based

Seeking

- Development partner
- Commercial partner
- Licensing
- Seeking investment