African Horse Sickness Virus Vaccine

A plant-produced, non-replicating virus-like particle vaccine against AHSV 4 and 5 with safety and immunogenicity data in equines

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Background

African horse sickness virus (AHSV) is considered a major health threat for horses in endemic areas in sub-Saharan Africa. It is an infectious, non-contagious disease spread by *Culicoides* sp. midges and notifiable wherever it is considered endemic. Outbreaks have previously extended to countries in North Africa, the Middle East, South-West Asia, Indonesia, India and the Mediterranean region

Vaccination against AHSV in South Africa is primarily through the use of a live-attenuated vaccine, comprising 2 polyvalent doses of three and four AHSV of the 9 known serotypes, excluding serotypes 5 and 9. However, potential reversion to virulence and reassortment with outbreak strains is a major concern and limits the use of the vaccine in other countries.

There is an urgent market need for a safe, recombinant, non-replicating vaccine against African horse sickness serotypes which is efficacious and can be produced using an economically viable means.

The University of Cape Town's Town's Biopharming Research Unit[1] has the experience and expertise in the designing and developing plant-produced reagents, vaccines and related technologies.

The researchers have developed a plant-produced, non-replicating virus-like particle (VLP) vaccine against AHSV serotypes 4 and 5, which has the potential for cross-protection against serotype 8. The safety, immunogenicity and *in vitro* neutralizing capabilities of this candidate have been demonstrated in equines.

1 https://science.uct.ac.za/department-mcb/biopharming-research-unit

Technology Overview

The presented technologies are plant-produced AHSV virus-like particle (VLP) vaccines against serotypes 4 and 5. Serotype 5 VLPs have been shown to cross-protect against AHSV serotype 8.

The VLPs have successfully been expressed in tobacco (*N. benthamiana*) plants. The VLPs are stable at room temperature, are non-replicating and are chimeric in design.

Safety and immunogenicity was successfully demonstrated in guinea pigs for AHSV serotype 5 VLPs[2] and for both AHSV 4 and 5 in horses[3] indicate that the VLPs were both safe and immunogenic.

The UCT Biopharming Research Unit can potentially design and produce VLPs representing additional AHSV serotypes 2, 7 and 9, which - when combined with ASHV 4 and 5 as a cocktail - could provide immunity against all 9 AHSV serotypes through cross-protection.

2 https://onlinelibrary.wiley.com/doi/full/10.1111/pbi.12783

3 https://veterinaryresearch.biomedcentral.com/articles/10.1186/s13567-018-0600-4

Benefits

The benefits of the University of Cape Town candidate vaccines include:

- **Non-replicating vaccine.** VLPs comprise recombinantly-expressed proteins and do not contain nucleic acids that could potentially recombine with outbreak or vaccine strains thereby reducing the risk of more virulent strain development.
- **Immunogenicity**. The published immunogenicity data in the target model (horses) demonstrated neutralization capability against AHSV serotypes 4 and 5 comparable to that achieved in horses immunized with the commercially available LAV. AHSV serotype 5 VLPs are also able to neutralize serotype 8 AHSV.
- **Polyvalent vaccine with cross-reactivity**. It may be possible to develop a multi-valent vaccine by combining VLP serotypes 4 and 5 together which would also provide cross-protections against serotype 8. Future developments could extend multi-valency by incorporating plant-produced VLPs targeting AHSV serotypes 2, 7 and 9.
- **Cost-effective scalability.** VLPs produced using the plant expression platform are cost-effective to make and the method is scalable.

Applications

Plant-produced virus-like particle (VLP) vaccines against African horse sickness has several potential applications, including:

1. **Prevention of the disease**: VLP vaccines can be used to prevent AHSV in horses and other equids. The VLPs mimic the structure of the virus that causes the disease, triggering the immune system to produce a response that protects against the real virus.
2. **Control of outbreaks**: In the event of an outbreak of AHSV, VLP vaccines could be produced quickly and in large quantities, allowing for a rapid response to contain the spread of the disease.
3. **Reduced cost**: Plant-produced VLP vaccines are potentially more cost-effective to produce than traditional vaccine production methods, which could make them more accessible to horse owners and breeders.
4. **Safer alternative**: VLP vaccines are non-infectious and do not contain live virus, which makes them a safer alternative to traditional vaccines that can sometimes cause adverse reactions in animals. The availability of a non-infectious AHSV VLP vaccine candidate is significantly more appealing than the live attenuated vaccine that is currently commercially available.
5. **Increased vaccine stability**: Plant-produced VLP vaccines have the potential to be more stable than traditional vaccines, which can be affected by temperature changes and other environmental factors. This increased stability could allow for easier storage and transport of the vaccine.

Animal owners notably may be more more willing to embark on a vaccination strategy employing such candidates. This will aid the export and quarantine procedures in the horse breeding trade, especially from Sub-Saharan Africa to destinations in the Middle East and elsewhere.

Opportunity

The University of Cape Town seeks partnerships with relevant players to bring the AHSV candidate vaccine to market. We would like to license the manufacture, sale and distribution of the vaccine. It is an option to complete the development of vaccines targeting additional serotypes to ultimately create a polyvalent vaccine to target a wider range of AHSV serotypes.

The key roles and partnerships needed include:

- a clinical trial partner with access to compliant animal facilities and resources to complete the requisite horse challenge trials to demonstrate efficacy;
- a manufacturer capable of expressing plant-derived protein at scale, compliant with GMP standards for the supply of the candidate vaccines for trials and later for supply to Pharma;
- access to funders who could invest in the opportunity to complete the planned activities; and
- a sales, marketing and distribution partner or network that the partner could access.

It would be possible to license the candidate vaccine to a single partner to co-ordinate the activities needed to bring this vaccine to market.

Patents

- PLANT-PRODUCED CHIMAERIC ORBIVIRUS VLPS. South African patent (2018/07464)
- PLANT-PRODUCED CHIMAERIC ORBIVIRUS VLPS United States patent (16095264) granted
- PLANT-PRODUCED CHIMAERIC ORBIVIRUS VLPS European patent application (2017720886)
- PLANT-PRODUCED CHIMAERIC ORBIVIRUS VLPS Namibian Patent application (2018/0034)
- PLANT-PRODUCED CHIMAERIC ORBIVIRUS VLPS ARIPO patent application (AP/P/2021/013697)

IP Status

- Patented
- Patent application submitted
- Know-how based

Seeking

- Licensing
- Commercial partner
- Development partner