R7362 – Developing a cheap and effective pen-side test for the rinderpest virus that differentiates between vaccinated and infected animals

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Executive summary

- Rinderpest remains a serious threat to the livelihoods of poor livestock owners in parts of east Africa and the Indian subcontinent.
- It is impossible under present field conditions to differentiate animals which have been vaccinated from those which are infected with the rinderpest virus.
- This project developed a simple serological test which can be carried out in the field to differentiate vaccinated from infected animals. Field testing is now required.
- Tests will enable animal health workers to quickly identify the area in which the disease remains endemic. They will then be able to contain its spread using ring vaccination and, ultimately, lead to worldwide eradication.
- Eradication will reduce livestock losses and increase the food supply of local farmers.

Project dates: May 1999 – March 2003

Background

Rinderpest has been largely eradicated from many countries, yet remains endemic in southern Sudan, Ethiopia, northern Kenya and Uganda. In Asia it is a problem in northern India, Pakistan and along the Afghanistan border.

It can kill off whole herds of animals, consequently leading to the impoverishment, and in some cases death, of their owners. The disease’s eradication in these areas will improve the livelihoods of rural poor by helping to provide a sustainable, enhanced supply of animal products with increased
Differentiating between animals treated with conventional Plowright rinderpest vaccine from those that have recovered from the disease is difficult. This poses major problems in interpreting serum surveillance data and discourages the use of ring vaccination to contain outbreaks.

In addition, rinderpest detection is increasingly difficult as most countries have ceased vaccination and are well on the World Organisation for Animal Health (OIE) Pathway to Eradication. Still, future control programmes will benefit from the devices developed under this project, particularly as Pestes des Petits ruminants (PPR) is a growing problem in parts of Africa and Asia.

**Objectives**
The project set out to develop an affordable and reliable pen-side test that could differentiate between antibodies produced by rinderpest or PPR viruses and those generated by genetically marked vaccines.

Such a test would enable both veterinary services and field officers to differentiate vaccinated from infected animals, making disease spread and endemic area identification easier. Vaccination campaigns could subsequently be undertaken to eradicate or control the disease and contribute to the success of the Global Rinderpest Eradication Programme (GREP).

**Highlights**
Project researchers developed prototype devices for antibody detection to rinderpest and green fluorescent protein (GFP) – the marker used in the vaccine. Both were evaluated in small-scale laboratory trials. Field trials, however, were not possible due to civil unrest in areas where rinderpest foci remain. Until a window of opportunity arises for field trials to take place, no further devices will be produced.

Recombinant expression systems were developed to produce rinderpest and PPR virus proteins (H and N). H and N-genes were cloned in both bacterial and baculovirus expression systems. Sufficient protein amounts were expressed, enabling the production of prototype chromatographic devices for small-scale laboratory trials. H, F and N rinderpest genes were cloned in the adenovirus expression system.

Researchers optimised purification procedures as well as expressed protein binding to both latex particles and nitrocellulose membranes. Prototype devices for detecting rinderpest and PPR antibodies were subsequently produced with a commercial partner, as well as antibodies to marker influenza HA and GFP proteins. Each device was evaluated in laboratory trials.

Antiserum test evaluation panels were raised in cattle for both rinderpest
and GFP. The variable carboxy-terminal regions of nucleocapsid proteins for both were expressed in baculovirus recombinants to help serologically distinguish between them. The antigens have a ‘His-Tag’ sequence to ease the purification process and assist in scaling-up production.

**Outputs summary**

1. Recombinant non-infectious rinderpest and PPR antigen were produced.
2. Chromatographic strip tests were established to identify rinderpest and/or PPR vaccinated animals as well as rinderpest and PPR antibodies.
3. Full field evaluation of the vaccines has not yet been possible due to civil unrest in Somalia and neighbouring areas of Kenya.

**Impact**

This project’s output will be a ‘pen-side’ diagnostic devices that differentiate between rinderpest and PPR infected and vaccinated animals. A pen-side diagnosis would mean temporarily confining stock in the field, taking blood samples, and carrying out a simple test to enable animal health workers to check on the spot whether animals were vaccinated or disease carriers.

Such simple tests would speed up identification of infection foci and allow for rapid introduction of control measures. Differentiation between infected and vaccinated animals will help in delineating rinderpest outbreaks and facilitate ring vaccination. In turn, this will reduce livestock losses and risks to farmers’ livelihoods and should ultimately increase livestock supplies for home consumption and market sale.

Should field tests prove to be successful, results will also enable authorities to accurately assess the status of animals coming into their country, including any illegal movement of vaccinated animals. This information could improve cattle trading between nations without fear of spreading these diseases.

Such test results could also give a significant final boost to the eradication of the disease. Eventual eradication will not only improve farmers’ livelihoods but also save developing countries and international agencies millions of dollars currently spent on animal health programmes. The authors are actively cooperating with institutions in Africa and Asia to organise a field trial of marked vaccines.

**Next steps**

As rinderpest has been successfully eradicated in most parts of the world, vaccination is now prohibited in countries, such as Kenya, that have embarked on the OIE eradication pathway. It remains debatable whether vaccination will be allowed or not even if a serious outbreak arises in future.
In the event of a large rinderpest outbreak, the decision to vaccinate would be more easily made if a reliable marked vaccine were available. With this in mind, further tests of the vaccine are planned – under laboratory conditions – at the Muguga Laboratory, Kenya. Funding from international sources will be sought to use the marked PPR vaccine and associated tests for PPR control programmes.

Though the project developed the technology and reagents for rinderpest and PPR companion diagnostic tests for use with their respective marked vaccines, it is unlikely, given the recent progress in rinderpest eradication, that there will be a pressing need for rinderpest test devices. Further, an eradication campaign for PPR is unlikely without significant international funding and strong pressure from countries suffering from PPR infections.

If PPR control is to be seriously considered, it will require significant funds (from sources such as the European Union, DFID, USAID, FAO etc.) to mount a similar campaign to that which successfully reduced the incidence of rinderpest to virtually zero. Such a decision is unlikely to be considered without using a marked vaccine and its associated tests.

Related projects
- R4661 – Using sheep and goat pox vaccines to control rinderpest, PPR, bluetongue and foot and mouth diseases
- R5033CB – Field trials of the capripox/rinderpest recombinant virus
- R5504 – Inducing immune responses
- R6557 – Field trialling of the capripox/rinderpest recombinant virus
- R7048 – Developing a genetically marked rinderpest vaccine