Genetically marked vaccines for improved control or eradication of Rinderpest and antigenically related diseases

SUMMARY:

Rinderpest is a serious contagious disease of cattle, Asian buffalo, yak and many other herbivores both domesticated and wild, including swine, African buffalo, giraffe and lesser kudu. Rinderpest is caused by a virus which is related closely to that of human measles, canine distemper, peste des petits ruminants and other viruses in the morbillivirus subgroup of the paramyxoviruses. Rinderpest, pests de petits ruminants (PRP) and diseases caused by the capripox virus are major and potentially economically crippling diseases of livestock in many parts of the World, especially Sub-Saharan Africa. The need to control these two important groups of diseases was approached through the development and testing of a recombinant capripox virus-rinderpest vaccine. This dual capripox / rinderpest virus vaccine protects cattle against lumpy skin disease and rinderpest and sheep and goats against pox diseases under African conditions.

KEYWORDS:
Capripoxvirus [1]
Rinderpest [2]
Cattle [3]
Lumpy skin disease [4]
Africa [5]
Vaccination [6]
monitoring [7]

CATEGORY:
Capacity development [8]
Livestock production [9]

COUNTRIES:
Kenya

DESCRIPTION:

Background

Rinderpest, pests de petits ruminants (PRP) and diseases caused by the capripox virus are major and potentially economically crippling diseases of livestock in many parts of the World, especially Sub-Saharan Africa. The need to control these two important groups of diseases was approached through the development and testing of a recombinant capripox virus-rinderpest vaccine.

Diseases caused by capripox viruses are estimated to affect around 650 million sheep and goats (pox diseases) and 250 million cattle (in the form of lumpy skin disease) This constitutes a massive economic burden for many resource- poor farmers in Africa, damaging their livelihoods and ability to increase their income. The current vaccines are expensive and difficult to deliver as they need a sophisticated cold chain.
**Peste des petits ruminants** (PPR) is a viral disease of goats, and less commonly of sheep. Historically the disease was primarily associated with West Africa, but it extends in a belt across Africa immediately south of the Sahara, extending into the Arabian Peninsula. South Asia has increasingly become a focus of the disease, where the disease causes serious losses among small ruminants. Control of PPR outbreaks relies on movement control (quarantine) combined with the use of focused (‘ring’) vaccination and prophylactic immunization in high-risk populations.

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Control of Rinderpest has been by mass vaccination programmes. As the disease was increasingly brought under control, movement restrictions, combined with quarantine, became of greater importance. Recently, in the last ten years, GREP (the FAO's Global Rinderpest Eradication Programme) [LINK: http://www.fao.org/ag/AGAinfo/programmes/en/grep/home.html [10]] has promoted a strategy in which mass vaccination has been withdrawn, allowing for the disclosure of reservoirs of endemic rinderpest responsible for maintenance of the disease. Once detected, these reservoirs can be eliminated by intensive vaccination of the relevant cattle populations. When there was confidence that the virus had been eliminated, all vaccination was withdrawn and activities focused on intensive surveillance to confirm the absence of infection. According to GREP, if the disease was to be reintroduced or surface in countries currently free of the disease, it would be eliminated by a combination of quarantine movement control and focal vaccination, with slaughter of affected herds if possible. 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.

Cessation of rinderpest vaccination is an essential step in the eradication process, but this will necessarily be followed by a rise in the percentage of susceptible animals. More animals will be at risk of contracting rinderpest and a rapid response to any disease incursion is essential. Routine surveillance is also essential to the eradication programme.

One of the problems is that it is not currently possible to differentiate between vaccinated and infected animals. Current rinderpest vaccines cannot be used in a country where rinderpest has been eliminated and that country wishes to declare itself 'rinderpest-free'. *Peste des Petits ruminants* (PPR) virus, antigenically related to rinderpest, is also found in many parts of the world where rinderpest is endemic. Rinderpest vaccine is routinely used for vaccinating sheep and goats against PPR.

Therefore a genetically marked vaccine that helps animal health workers differentiate animals that have a natural infection from those animals that are vaccinated is of significant benefit to control programmes.

**Vaccine Development**

New vaccines have been developed at the Institute of Animal Health (IAH), Pirbright, UK. Genetically marked vaccines can be produced by altering or inserting genes at at specific sites in the virus. The use of a marked rinderpest vaccine would allow ring vaccination to contain any rinderpest outbreaks and assist in the monitoring of cordons sanitaire, or immune belts. The researchers genetically engineered viruses and these were shown to function efficiently as vaccines. These vaccines were able to protect cattle against challenge by highly pathogenic strains of rinderpest, and goats against the antigenically related PPR virus. Tests indicated that animals were fully protected from clinical disease (see WALSH et al [11], 2000).

Rapid and specific pen-side tests were also developed for the detection of antibodies against rinderpest and PPR viruses. Prototype devices for, on the one hand, detection of rinderpest, and on the other hand, detection
of GFP antibodies (the marker used in the vaccine) are now available and have been evaluated in small scale laboratory trials.

The use of marked vaccines combined with appropriate pen-side tests would allow differentiation of vaccinated from infected animals and facilitate the use of focussed ring vaccination to control incursions of rinderpest and assist in monitoring of barriers or cordon sanitaire.

The potential to use a marked vaccine for rinderpest, along with the associated tests, now exists. However, the success of the global rinderpest eradication campaign has so far meant that there is no great pressure to introduce this technology. Looking to the future, this has indicated how the control or eradication of similar virus infections, especially PPR in small ruminants, can be addressed.

A dual vaccine against rinderpest and LSD in cattle has also been produced at IAH, and successfully tested in Kenya. A similar trial was undertaken with sheep and goats for PPR. A dual vaccine that can protect cattle against rinderpest and LSD, and smallstock against PPR would be of great economic benefit to many poor farmers in areas of the world where these diseases co-exist. The vaccine would also enable animal health workers to distinguish between vaccinated animals and those suffering from rinderpest. This would be a very useful tool in areas where mass vaccination was being stopped.

Further reading


BLACK, D.N. and BOSTOCK, C.J. [15](1996) Using sheep and goat pox vaccines to control rinderpest, PPR, bluetongue and foot and mouth diseases. Improvement of the capripox¿rinderpest recombinant vaccine through the use of alternative promoters for expression of rinderpest genes. DFID Animal Health Programme, Project Summary, Project R4661.


immune responses. Institute for Animal Health (IAH), Compton, UK.


e-Resources

FAO. Global Rinderpest Eradication Programme.


FAO. Animal Health Disease Cards. Sheep and Goat Pox.

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Links: