Assessment of seroconversion to a peste des petits ruminants virus live vaccine in Arabian oryx (Oryx leucoryx)

R. C. C. Sa, T. A. Bailey, D. O’Donovan, U. Wernery, C. P. Kilgallon

PESTE des petits ruminants (PPR), caused by the PPR virus (PPRV), a Morbillivirus from the family Paramyxoviridae, is a well-recognised disease of small ruminants (Gibbs and others 1979) of exceptional importance in affected countries (OIE 2012). It also affects many species of wild small ruminants (Gür and Albayrak 2010), and was found to cause significant losses in captive wild hoofstock throughout the United Arab Emirates (UAE) in 2005/2006 and 2008/2009 (Kinne and others 2010). Such outbreaks might represent a significant extinction threat to valuable populations in the area. Because culling is not desirable, prophylactic approaches to disease protection, such as effective vaccination programmes are to be favoured.

Although a live attenuated vaccine has been shown to be protective in domestic small ruminants, (Dialog and others 1989), there are no documented reports of PPRV vaccine trials in exotic hoofstock. The purpose of this study was to investigate and document seroconversion in one species of wild ungulate, the Arabian oryx (Oryx leucoryx) in response to inoculation with a commercially available PPRV vaccine.

Fifteen healthy (based on physical exam and haematology) Arabian oryx from a private wildlife collection in Dubai, UAE (8 males; 7 females; 11–32 months old), were used in this study. For sampling, animals were restrained using a runway-drop chute system (Tamer; Fauna Research, USA) as described by O’Donovan and Bailey (2006). Preliminary serum from each animal was screened for PPRV antibodies using a commercial PPR C-ELISA Kit (Biological Diagnostic Supplies (BDSL) prepared by the Institute for Animal Health (IAH) (Pirbright, UK)). All samples were negative.

Pestevac (Jordan Bioindustries centre, Amman, Jordan), a live homologous attenuated PPR vaccine prepared from the strain Nig. 75/1 with $1 \times 10^2$ TCID$_{50}$ per dose was chosen for the study. Test subjects were placed randomly into three groups. Seven animals received a single 2 ml dose of vaccine (VS) subcutaneously near the elbow on day zero; five received a booster 30 days later (VB). Three animals were used as controls (C) receiving 2 ml of sterile water once. All animals, including controls, were given an annual booster 12 months after the start of the study as part of the collection’s prophylactic disease management protocol.

Blood was sampled (jugular) on 16 occasions over 357 days; day zero prior to first inoculation; weekly over the first two months; monthly between two and six months; and at approximately one year postvaccination, coinciding with the administration of the annual booster. Following separation, sera was stored at $-80^\circ$C prior to analysis at the Central Veterinary Research Laboratory (Dubai, UAE).

PPR antibodies were measured using a competitive PPR C-ELISA Kit as previously described (Anderson and others 1991). Results reflect variations in measured optical density (OD) corresponding to percentage of inhibition (PI) in the reactivity of the monoclonal antibody (Mab) due to the presence of antibodies in the serum (PI=$100$–(OD of the sample/OD of the control)$\times$100). Samples with a PI$\geq$50 per cent, when compared to wells containing the controls, are considered positive.

All controls remained seronegative throughout the study (PI$<50$ per cent) up to administration of an annual booster at day 357 postvaccination. Conversely, all animals in the VS and VB groups developed a PI above 50 per cent and remained above this threshold throughout the period of analysis. Eight of the twelve (67 per cent) vaccinated animals had seroconverted by day 14, and by day 21 all vaccinated oryx had developed antibodies above the 50 per cent threshold, (PI$=66.1 \pm 6.6$, max$=75.5$, min$=54.0$). Overall, there were no significant differences between the PI values for VS and VB during the study. See Fig 1 for results.

This is the first study documenting seroconversion in response to a PPRV live vaccine in Arabian oryx. Although a PPRV homologous vaccine produced by the serial passage of strain 75/1 of PPRV in VB rats is known to be protective in domestic small ruminants (Jovac 2001, Khan and others 2009, OIE 2012), its effectiveness in wild ungulates has up to this point been unknown.

Virus neutralisation (VN) and competitive ELISA (C-ELISA) tests are the serological tests most frequently used for surveillance of exposure to this disease. Although VN is sensitive and specific, it is time consuming (Libeau and others 1994). By contrast, C-ELISA N and H tests are rapid owing to the use of a monoclonal antibody directed to the nucleoprotein specific for PPRV (Libeau and others 1995).

The response to a PPR vaccine is considered satisfactory if positive serum neutralisation occurs within three weeks of vaccination (OIE 2012). All twelve vaccinated oryx in the present study demonstrated values of PI$>50$ per cent by day 21 postinoculation, similarly to that expected of the target domestic small ruminants. Although the C-ELISA test reveals the presence of antibodies, a standard neutralisation test would be necessary to demonstrate that these are neutralising antibodies (Singh and others 2004, OIE 2012).

Additionally, PI remained above 50 per cent in all vaccinated animals for at least 357 days postvaccination (Fig 1). This is similar to results reported in Kirdi goats and Foulke sheep (Awa and others 2002), where seroprevalence remained positive (PI$>50$ per cent) for at least one year postinoculation. OIE recommends that satisfactory immunity should last for three years (FAO 1999, OIE 2012). The vaccine manufacturer, however, recommends that an annual booster should be administered to maintain protective immunity levels (Jovac 2001).

To conclusively show whether seroconversion to this PPR vaccine protects the Arabian oryx against the disease would require live virus
challenge, logistically and practically unfeasible. However, the results presented strongly suggest that vaccination of Arabian oryx with a single dose of a homologous live attenuated PPRV vaccine produces antibodies levels comparable to those known to be protective in small domestic ungulates (Singh and others 2004, OIE 2012).

The conservation value of exotic ungulates, which are extremely susceptible to PPRV, emphasises the importance of species-specific vaccination programmes as a critical preventative medicine tool throughout the Middle East. Having demonstrated the effectiveness of a commercial PPRV vaccine in Arabian oryx, future studies may elucidate a similar application for a variety of species unique to the region.

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FIG 1: Mean of percentage inhibition on Arabian oryx vaccinated with a single dose (VS) and a booster (VB) through time from day zero until day 357, when they were administered the annual booster. Controls were negative throughout the whole testing period.
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