

The control of sheep and goat pox

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Summary: A single vaccine against sheep and goat pox (capripox) has been developed to protect sheep and goats throughout the capripox enzootic area. Preliminary field trials in the Middle East have indicated that the vaccine is highly effective in the control of capripox in indigenous breeds of sheep and goats.

KEYWORDS: Disease control - Experiments - Goat pox virus - Middle East - Sheep pox virus - Vaccines.

INTRODUCTION

Sheep pox and goat pox are malignant pox diseases of sheep and goats characterized by fever and generalized pocks. They are caused by members of the Capripox-virus genus of pox viruses. Kitching and Taylor (6) have shown that strains of capripoxvirus are not host-specific and that, although the majority of strains do show a host preference, single strains can cause disease in both sheep and goats. Goats may become mildly infected with sheep strains which could cause severe disease when transmitted back to sheep, and similarly sheep can be infected with virulent goat strains. The separate reporting of sheep pox and goat pox can thus be misleading, and it has been proposed that both diseases be included in the single description, capripox (6).

EPIDEMIOLOGY

Capripox is enzootic throughout Africa, the Middle and Far East, over an area which supports in excess of 650 million sheep and goats (4). Europe, Australasia and North and South America are free of the disease. Sheep and goats are very important to the economy of most of the enzootic area, and capripox is an additional burden on animals already suffering from a complex of nutritional and parasitic diseases. Mortality can exceed 50% in young animals (1, 16, 17) and, although indigenous sheep and goats do have some natural immunity to the disease (10), mortality in older animals can reach 90% when capripox is superimposed on another viral condition such as peste des petits ruminants (PPR). European breeds of sheep and goats are very much more susceptible to capripox, and mortality may reach 100% (6).

In capripox enzootic countries, the disease reduces the productive potential of the existing sheep and goat industries, and limits the development of intensive feedlot systems and the improvement of indigenous breeds of sheep and goats with exotic breeds (18, 20). However, the appearance of capripox in a country previously free of the disease can have even more severe economic consequences.

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Capripox-free countries maintain their status by controlling the importation of sheep and goats and their products from enzootic areas. Control of the disease, once it has entered, is usually by slaughter of affected and in-contact animals, vaccination of neighbouring flocks with a dead vaccine, and strict animal movement controls. In addition, the introduction of capripox can close important export markets, as occurred in Italy in 1983 (12) and Cyprus in 1985 (13).

CONTROL MEASURES

In most countries in which capripox is enzootic, a slaughter policy would be impracticable and movement controls impossible to enforce. In these countries vaccination is considered the only suitable control measure. There have been numerous attempts to produce an acceptable dead capripox vaccine (5), but the experience of workers attempting to produce a dead smallpox vaccine (21) would suggest that a replicating antigen is required for the development of effective immunity against pox disease. A similar conclusion has been reached with the control of capripox, as live capripox vaccines are now generally recommended, even by those who originally described the use of dead preparations (2, 3, 14, 15, 19).

Capripox vaccines are prepared separately for sheep and for goats, thus making difficult their administration in the mixed flocks of the Middle East and North Africa. Further, capripox vaccines have tended to be produced from local virulent strains of capripoxvirus for local use. This has frequently resulted in vaccines acquiring a bad reputation because of inconsistent supply and quality. However, the loss of vaccine titre in imported vaccines due to airport delays and exposure to high temperatures has encouraged the belief that vaccines should be prepared from local isolates.

In view of these problems, it is surprising how little comparative research has been carried out on capripox. Part of this is undoubtedly due to the serious nature of the disease, and the reluctance of countries to import dangerous pathogens. In this respect the Animal Virus Research Institute, Pirbright, is almost unique in being able to provide suitable security and isolation facilities for such a study.

Field and vaccine isolates of capripoxvirus from sheep and goats were collected from Nigeria, Turkey, Sudan, Kenya, Sultanate of Oman, Yemen Arab Republic, Pakistan, India and China. It was found that isolates from sheep and goats could not be distinguished by their gross clinical pathology or using serological tests (6). It was also shown that animals that had recovered from infection with one isolate, however mild, were totally resistant to challenge with any other isolate, however virulent, whether derived from a sheep or goat or whether from a neighbouring country or from the other extreme of the capripox enzootic area (6, 9).

TESTING OF THE ATTENUATED VACCINE

The Kenya isolate, originally isolated by Davies (2) was selected as a potential vaccine because it produced only a mild infection following experimental inoculation, and because it had no clear preference for either sheep or goats. Following further attenuation in lamb testis (LT) cells and baby hamster kidney (BHK) cells, this vaccine (LT/1, BHK/2, LT/4) was tested in British breeds of sheep and goats (9).

Vaccinated animals were examined for any adverse reaction to either the vaccine or possible vaccine contaminants. Pre- and post-vaccination serum samples were examined for the development of antibodies to foot-and-mouth disease, blue-tongue, rinderpest, PPR and bovine virus diarrhoea viruses, and the vaccine was itself tested *in vitro* for the presence of virus or bacterial contaminants.

The vaccine should be given diluted by subcutaneous injection. However, if the concentrated vaccine was inadvertently given intradermally, a small papule would develop at the inoculation site. Kitching and Mellor (11) have shown that insects are capable of transmitting capripox, and therefore the possibility would exist for the insect transmission of the vaccine virus. Cattle, sheep and goats were inoculated intradermally with neat vaccine, and the vaccine virus was transmitted using biopsy material obtained from the reaction site. In this manner the vaccine virus was passaged twice in cattle, twice in sheep and four times in goats. In the cattle and sheep it was not possible to recover virus after the second passage; in goats, while vaccine virus was still present on the fourth passage, there was no change in its virulence. There was no transmission of the vaccine virus by contact or vertically in pregnant animals (9).

Six sheep and six goats were vaccinated subcutaneously with $10^{3.2}$ TCID₅₀ of vaccine and each animal, together with a control, was challenged 21 days later with a virulent field isolate. These isolates had been collected from goats in the Yemen Arab Republic, Sultanate of Oman and China and from sheep in Nigeria, Sultanate of Oman and China. The animals were examined daily and rectal temperatures recorded. In all cases the vaccine protected the sheep and goats against challenge with virulent field virus. The three control sheep inoculated with the Nigerian and Chinese sheep isolates and the Yemen goat isolate died of capripox within 14 days of inoculation, and the four control goats inoculated with the goat isolates and the Oman sheep isolate died of capripox also within 14 days; the remaining control animals recovered (9, 10). Figs. 1-8 show the temperature response of animals challenged with the Oman and Chinese isolates.

Sheep and goats were more sensitive to the vaccine virus than the *in vitro* vaccine potency test carried out in LT cells. Animals vaccinated with less than one TCID₅₀ were immune to challenge with Yemen capripox. Immunity in sheep and goats vaccinated with $10^{3.2}$ TCID₅₀ of vaccine persisted for at least a year although, after this time, there was evidence of challenge virus replication in the vaccinated animals (9).

The vaccine was also tested in the Yemen Arab Republic and the Sultanate of Oman. Indigenous sheep and goats were vaccinated and, together with control animals, were challenged with the virulent capripox isolates originally collected from these countries. Although the control animals reacted less severely to challenge than the British sheep and goats, the vaccine clearly protected the locally bred animals. The response to vaccination was confirmed using the agar gel immunodiffusion test (AGID) on pre- and post-vaccination sera to show the development of precipitating antibodies to capripoxvirus antigen (8). Many of the vaccinated sheep and goats also showed a delayed type hypersensitivity reaction at the site of challenge virus inoculation. A further 191 (79%) of 242 locally bred goats, 98 (83%) of 118 locally bred sheep and 34 (97%) of 35 imported Merino sheep developed precipitating antibodies to capripoxvirus following vaccination.

Almost one million doses of this vaccine have now been used in the Middle East to control capripox in sheep and goats.

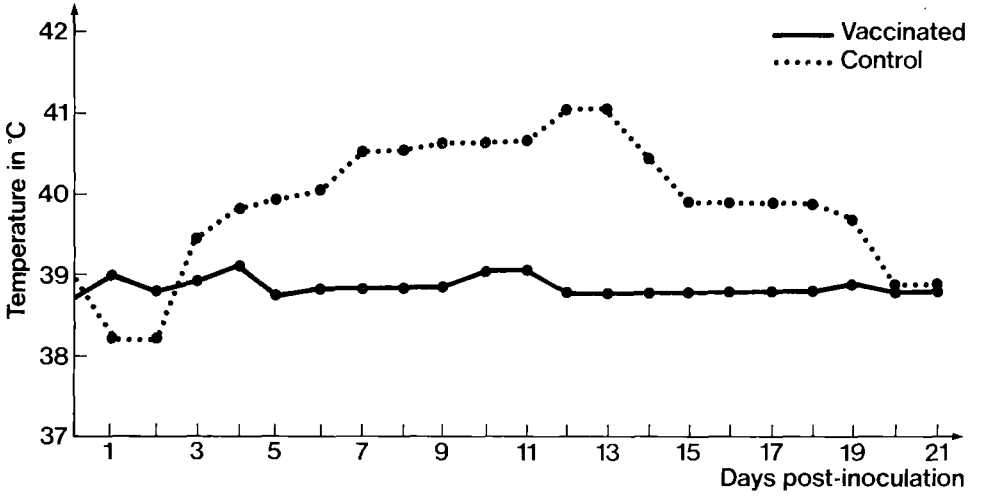


FIG. 1
Oman sheep pox inoculated into sheep

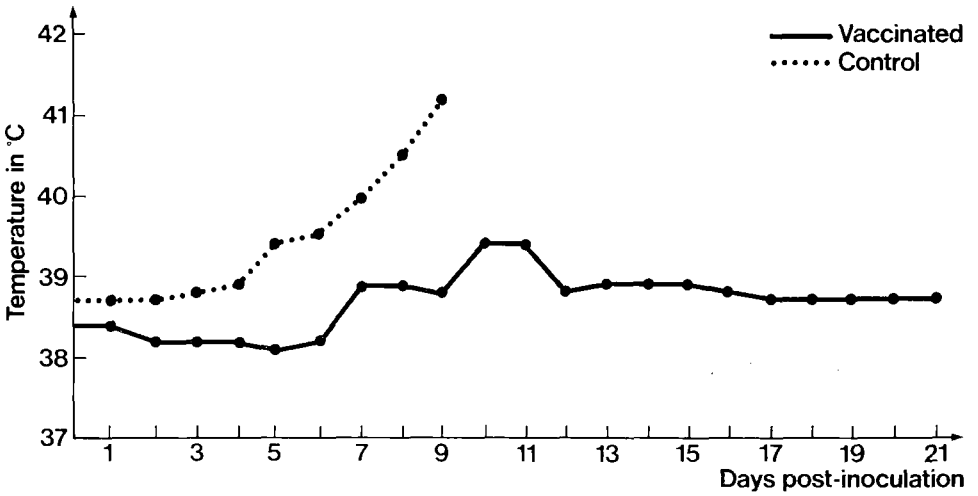


FIG. 2
Oman goat pox inoculated into goats

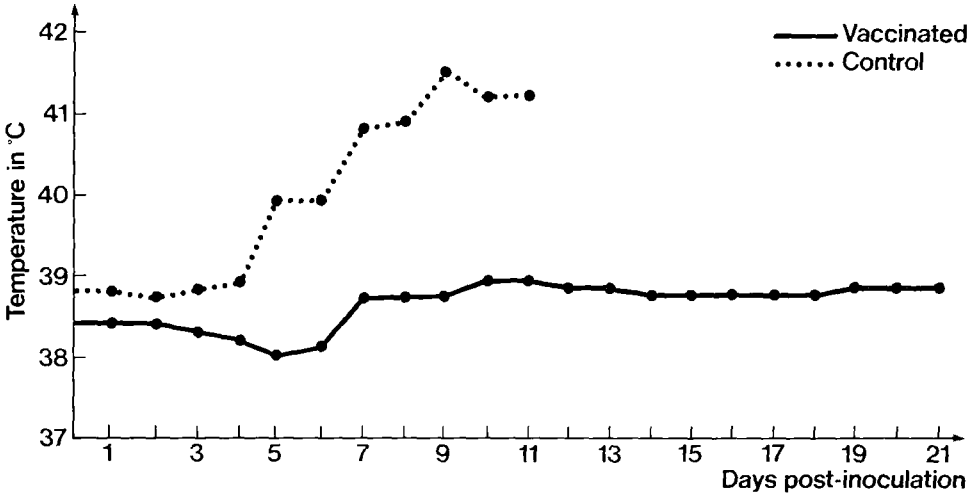


FIG. 3
Oman sheep pox inoculated into goats

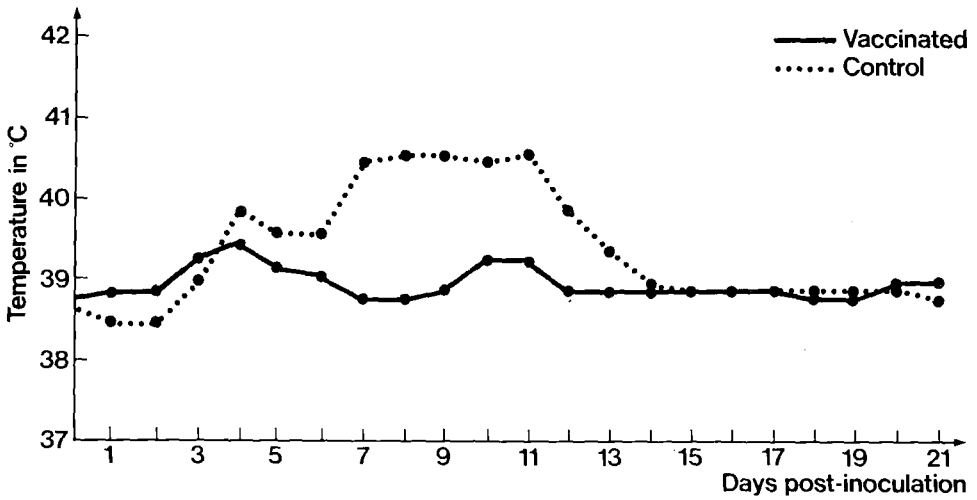


FIG. 4
Oman goat pox inoculated into sheep

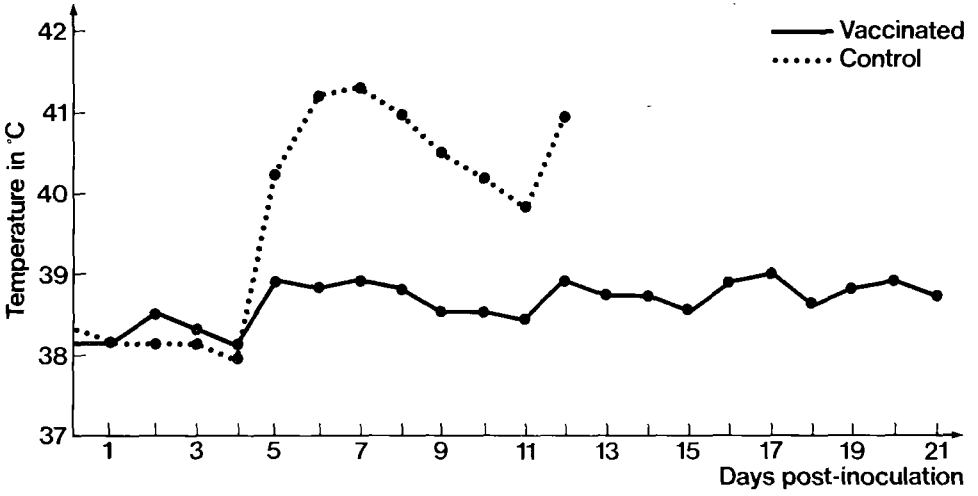


FIG. 5
Chinese sheep pox inoculated into sheep

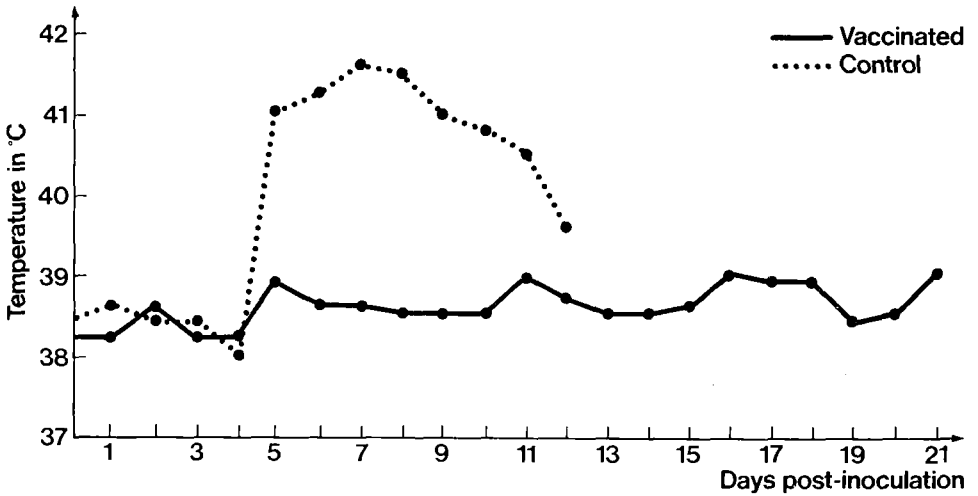


FIG. 6
Chinese goat pox inoculated into goats

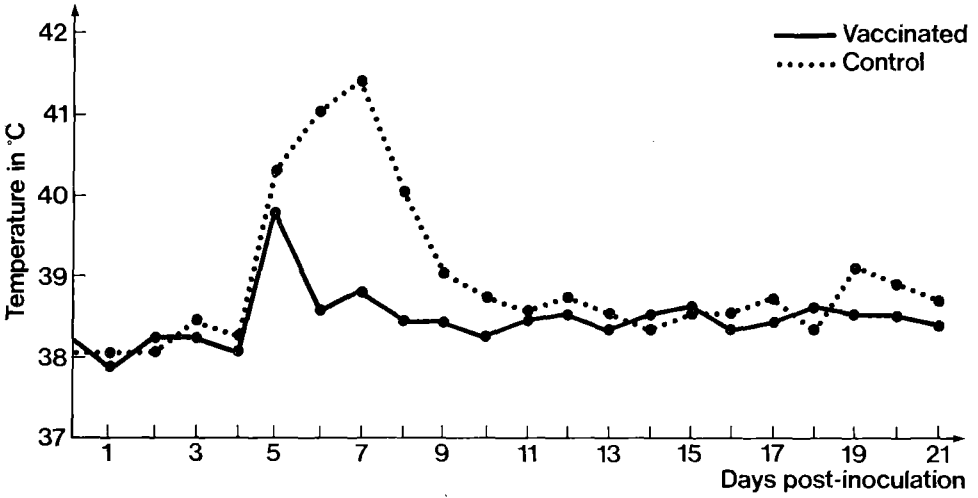


FIG. 7
Chinese sheep pox inoculated into goats

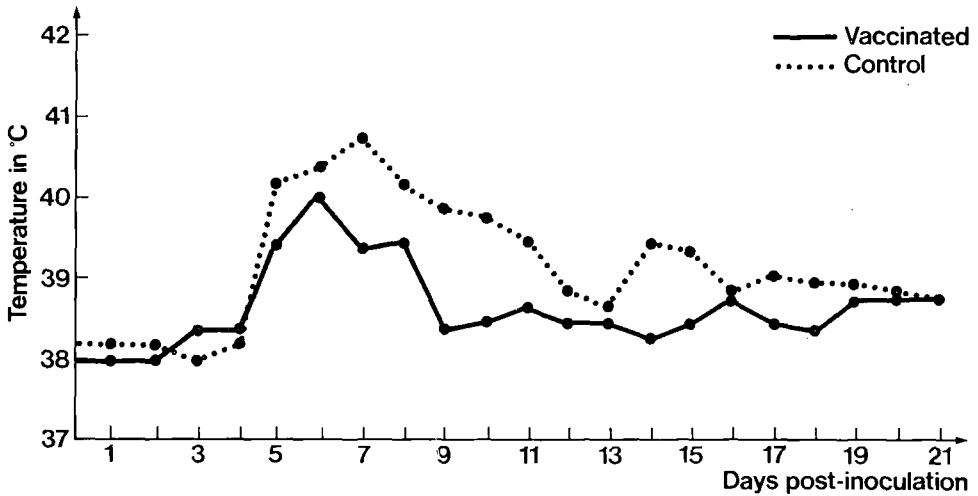


FIG. 8
Chinese goat pox inoculated into sheep

CONCLUSION

The epidemiology of capripox has much in common with that of smallpox (7). It is my opinion that, in the same way that smallpox was controlled and eradicated, capripox could be eliminated. However, the African experience with rinderpest would suggest that the development of a safe and effective vaccine is not all that is required.

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LA PROPHYLAXIE DE LA CLAVELÉE ET DE LA VARIOLE CAPRINE. — R.P. Kitching.

Résumé : Un vaccin unique contre la clavelée et la variole caprine (capripoxvirus) a été mis au point pour protéger les ovins et les caprins dans les zones où ces maladies existent sous forme enzootique. Des essais préliminaires réalisés sur le terrain au Moyen-Orient indiquent que le vaccin est très efficace dans la prophylaxie de ces maladies chez les ovins et les caprins de race autochtone.

MOTS-CLÉS : Expériences - Moyen-Orient - Prophylaxie - Vaccins - Virus de la clavelée - Virus de la variole caprine.

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CONTROL DE LA VIRUELA OVINA Y DE LA VIRUELA CAPRINA. — R.P. Kitching.

Resumen : Se ha elaborado una vacuna única contra la viruela ovina y la viruela caprina (capripoxvirus) para proteger ovinos y caprinos en las zonas en las que existen estas enfermedades con carácter enzoótico. Algunas pruebas preliminares de campo realizadas en Medio Oriente indican que es muy eficaz la vacuna en el control de estas enfermedades en ovinos y caprinos de raza autóctona.

PALABRAS CLAVE : Control - Experiencias - Medio Oriente - Vacunas - Virus de la viruela ovina - Virus de la viruela caprina.

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