

## Effects of live *Brucella abortus* strain 19 vaccine on reindeer.

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**Abstract:** Twenty female and seven male reindeer (*Rangifer tarandus*) were vaccinated subcutaneously in the right shoulder with a 1-ml dose of approximately  $1.2 \times 10^8$  colony forming units of *Brucella abortus* strain 19, the standard reduced dose for cattle. An additional three females and one male served as non-vaccinated sentinels. *Brucella abortus* strain 19 was isolated from two of three fetuses aborted by vaccinated females during the first of two fawning seasons. Serologic titers to brucellosis in the vaccinates peaked by 46 days post-vaccination. Shedding of *B. abortus* strain 19 by vaccinated animals was indicated by seroconversion of all four sentinels. Titers in the sentinels were low and sporadic. *Brucella abortus* strain 19 was isolated from the tissues and fetus of a pregnant female 51 days post-vaccination and from the carpal joint of another female 7 months post-vaccination. Based on these results and a previous challenge experiment, it was concluded that *Brucella abortus* strain 19 is not a suitable vaccine to use in a brucellosis control program in reindeer.

**Key words:** Reindeer, brucellosis, vaccine.

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### Introduction

Reindeer were first introduced to Alaska from Siberia for use by the Eskimos in 1892. The Alaska Native Claims Settlement Act stimulated the growth of the commercial reindeer industry with approximately 30,000 animals now being herded. Brucellosis, caused by *Brucella suis* type 4, is endemic in Alaskan reindeer (*Rangifer tarandus*) (Meyer 1966; Dieterich 1981). This disease decreases the production potential of commercial reindeer herds in western Alaska by causing abortion in females and sterility in males.

Several vaccines have been tested for their efficacy for protection against infection of brucellosis in reindeer (Dieterich et al. 1980; 1981). Although *Brucella abortus* strain 19 has been used to prevent brucellosis in reindeer in Russia (Davidov 1974; Golosov et al. 1986; Nikolaevskii, L. D. 1968.), a recent study in

Alaska questioned the efficacy of *Brucella abortus* strain 19 against challenge exposure with *B. suis* type 4 in reindeer (Dieterich et al. 1987). Because vaccination with live *B. abortus* strain 19 itself is a potential hazard in cattle, the effects of the vaccine on non-challenged reindeer were examined.

### Materials and methods

**Facilities** – During the study, all reindeer were maintained together in an outside paddock measuring 100 m x 100 m. The paddock was snow-covered (depths from 0.25 to 0.5 m) during winter and grass-covered during summer. Winter and summer supplemental feed consisted of a commercial grain and pellet mixture<sup>1</sup> given ad libitum in troughs.

<sup>1</sup> Quality Texture, Fisher Mills Inc., Seattle, WA.

*Experimental procedure* - Thirty-one adult reindeer (*Rangifer tarandus*) were placed in the paddock in late November, 1979. Twenty-three of these were mature females that had been with males during the September-October rutting season and were assumed to be pregnant. The remaining eight were males. Prior to the investigation, all 31 reindeer were seronegative for *Brucella* by the standard plate (SP), Rivonal (Riv), buffered *Brucella* antigen (BBA), and complement fixation (CF) tests.

On December 3, 1979, 27 of these reindeer (20 females and 7 males) were vaccinated subcutaneously in the right shoulder with a 1-ml dose of approximately  $1.2 \times 10^8$  colony forming units (CFU) *Brucella abortus* strain 19 vaccine, the standard reduced dose in cattle. The remaining four animals (three females and one male) were unvaccinated sentinels. Reindeer were observed through the spring of 1980 for abortions, fawning, and fawn survival. Aborted fetuses and non-viable fawns were necropsied as soon as possible after being found. Healthy fawns born during the first spring were necropsied during the summer of 1980.

Eleven vaccinates (seven females and four males) and two sentinels (one female and one male) died or were euthanized during the first year. The remaining 16 vaccinates (thirteen females and three males) and 2 sentinels (females) were observed for a second year. They were allowed to breed in the fall of 1980 and were monitored for abortions or fawning during the spring of 1981. All adult reindeer and their remaining fawns were necropsied between April and August 1981.

During the 2-year investigation, serologic and bacteriologic examinations were conducted on blood and body tissues using standard techniques as previously described (Dieterich, 1981). Blood samples were collected by jugular venipuncture at approximately bi-monthly intervals between January of 1980 and April of 1981. Vaginal swabs, milk samples, and blood samples were collected immediately post-parturition or post-abortion for bacteriologic and serologic examination. Tissues examined bacteriologically at necropsy included: retropharyngeal, mandibular, parotid, superficial cervical, subiliac, popliteal, medial iliac, mesenteric, mediastinal, tracheo-

bronchial, supramammary or superficial inguinal lymph nodes, and portions of heart, liver, lung, kidney, spleen, biceps femoris muscle, uterus, cervix, testes, epididymides, seminal vesicles and urine. Tissues of fluids were collected from other areas if lesions were observed.

## Results

During the first fawning season, six vaccinates were non-pregnant, three aborted, four had weak, non-viable fawns, and seven had healthy fawns. One sentinel was non-pregnant, one had a weak, non-viable fawn, and one had a healthy fawn.

During the second fawning season, one vaccinate was non-pregnant, one had a weak, non-viable fawn, and eleven had healthy fawns. One sentinel had a weak fawn, and the other had a healthy fawn.

Results of serologic tests on vaccinates and sentinels are shown in Figure 1. All 27 vaccinates and 1 of the 4 sentinels were seropositive by 23 days post-vaccination (PV). Serotiters were detected in three of the four senti-

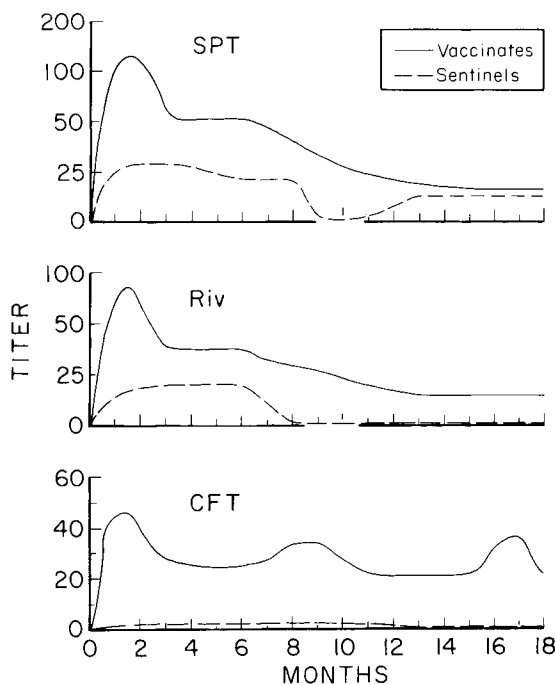


Fig. 1. Geometric mean titers of reindeer vaccinated with *Brucella abortus* strain 19 and non-vaccinated sentinels.

nels at 46 days PV. Titers in vaccinates tended to peak by 46 days PV and gradually declined after that. CF titers in the vaccinates rose during July and August in 1980 and during March and April 1981. Intermittent titers on the SP and Riv tests were detected in the sentinels. Diagnostic titers ( $\geq 20$ ) on the CF test were not detected in any of the sentinels. Two of seven healthy and two of four non-viable fawns born to vaccinates were seropositive in 1980. Three of eleven healthy fawns born to vaccinates in 1981 were seropositive. The non-viable fawn born in 1981 was seronegative. Serotiters were not detected in any of the fawns born to sentinels in 1980 or 1981.

Two of two milk samples collected from vaccinates at fawning during the spring of 1980, and 5 of 11 collected during the spring of 1981 were seropositive for brucellosis by the BRT (*Brucella Ring Test*) or Whey test.

*Brucella abortus* strain 19 was cultured from the blood of 6 of the 27 vaccinates at 23 days PV, and from 2 of the 27 vaccinates at 46 days PV. All subsequent hemocultures of vaccinates, sentinels, and fawns were negative. *Brucella abortus* strain 19 was not cultured from milk samples collected at fawning or at necropsy.

In 1980, *B. abortus* strain 19 was isolated from two of three aborted fetuses of vaccinated females. The organism was not isolated from four non-viable fawns or seven healthy fawns born to vaccinates that year. In 1981, *B. abortus* strain 19 was not isolated from any of the eleven healthy fawns or the one non-viable fawn born to vaccinates. No healthy or non-viable fawns born to sentinels in either year were culture-positive for *B. abortus* strain 19.

Bilaterally swollen carpi were observed in one female 7 months PV, and *Brucella abortus* strain 19 was isolated from the right carpal joint. This female aborted 1 month PV the first year, and delivered a healthy, seronegative fawn the second year. *Brucella abortus* strain 19 was not isolated at necropsy from either the mother or the fawn.

One adult female vaccinate was euthanized 51 days PV due to extreme weakness. This female was seropositive, and *Brucella abortus* strain 19 was isolated from six lymph nodes, vaginal swabs, and fetal cultures at necropsy.

*Brucella abortus* strain 19 was not isolated from any of the other reindeer at necropsy.

## Discussion

Positive hemocultures at 26 and 43 days PV indicated bacteremias were limited to the early stage of infection. This corresponded to the time of detection of serotiters in the sentinels indicating the vaccine organism was shed by the vaccinates during that time.

Although most adult vaccinated domestic cattle are seronegative on the CF test within a few weeks following vaccination with strain 19 (Nicoletti 1977), several reindeer (8/16) in this study had diagnostic titers ( $\geq 20$ ) for 16–18 months PV. However, a few vaccinates in this study did not develop diagnostic titers on the Riv ( $\geq +25$ ) or CF tests at all (11/27 and 6/27 respectively).

In a previous study testing the efficacy of *Brucella abortus* strain 19 against challenge exposure with *Brucella suis* type 4 in reindeer, 7 of 11 vaccinated females aborted, gave birth to weak fawns that died, or were barren. In addition, *Brucella suis* type 4 was isolated from tissues of 4 of 11 vaccinates and from 2 of 7 of their fawns. *Brucella abortus* strain 19 was isolated from the tissues of 1 of 12 vaccinates cultured at necropsy.

Davidov (1974) reported *B. abortus* strain 19 induced good protection in reindeer against challenge exposure with *B. suis*. However, the differences in results could be attributed to the smaller challenge dose ( $10^4$  to  $10^5$  CFU *B. suis* type 4) used in his studies as opposed to ours ( $10^7$  CFU).

In the current study, only 7 healthy fawns were born to 20 adult female vaccinates the first spring following vaccination the previous December. Three females aborted, and *B. abortus* strain 19 was isolated from 2 of the fetuses. In addition, *B. abortus* strain 19 was isolated from tissues of a pregnant female at necropsy and from the carpal joint of a female which been vaccinated 7 months previously. Shedding of *B. abortus* strain 19 by the vaccinates was indicated by the seroconversion of all four of the sentinels.

Reindeer in western Alaska are usually corralled twice a year, in June for fawn-marking and antler harvest, and in mid-winter for herd separations and veterinary treatments. The

mid-winter handling time would be comparable to the December vaccination time in this study. Deleterious effects on female reproduction, swollen carpal joints in one animal, and shedding from vaccinates to non-vaccinates were demonstrated in this study. Golosov (1964) also reported precarpal bursitis and subsequent isolation of the vaccine organism in reindeer vaccinated with strain 19. In addition, lack of vaccine protection against challenge exposure was shown in the previous study. These results indicate *Brucella abortus* strain 19 is not a suitable vaccine for use in a brucellosis control program in reindeer.

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