

Antibody Responses of Young Calves to Inactivated Viral Vaccines

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Summary

Three commercial inactivated virus vaccines were evaluated for immunogenicity in young calves with residual maternal antibodies. Groups of 30 calves were administered each of the vaccines at the start of the experimentation and were administered a second dose 32 days later. Serum was obtained from these calves and 30 calves in a nonvaccinated control group prior to vaccination and at 32, 61, 99 and 125 days thereafter. Antibody responses to viruses in two of the vaccines were extremely limited. The third vaccine overcame suppression by maternal antibodies and elicited responses clearly differentiated from antibody levels in the control group of calves.

Introduction

A number of viruses including bovine viral diarrhea (BVD), infectious bovine rhinotracheitis (IBR), parainfluenza type 3 (PI-3), and bovine respiratory syncytial (BRS) virus are ubiquitous in our cattle population. Consequently, cows in most herds possess antibodies to these viruses either as a result of natural infection or vaccination. These antibodies are transferred to a newborn calf by ingestion of colostrum and may protect the calf from infection during early life.

While these maternal antibodies may be protective, they also may interfere with induction of acquired immunity by vaccination. This interference relates directly to the level of antibodies in the vaccinated calf. The level of antibodies among calves in a herd may be extremely variable, and this situation contributes to a major problem. Many calves cannot be effectively immunized at a time when other calves are susceptible to natural infection.

Commercial vaccines available for immunization of cattle contain either modified-live or inactivated viruses. Maternal antibodies may interfere with induction of immunity by either type of vaccine. Modified-live virus vaccines have been reported to be particularly susceptible to antibody interference. There are recent indications that appropriately formulated inactivated vaccines may be effective in inducing active immunity even in the presence of maternal antibodies. The objective of this experimentation was to evaluate the immunogenicity of three commercial inactivated virus vaccines in young calves with residual maternal antibodies.

Materials and Methods

One hundred twenty calves in the Rhodes Farm Research beef herd were selected and randomly assigned to one of four

groups of 30 animals each. These calves were of mixed breeding, born in the Spring of 1995, and ranged in age from 28 to 69 days at the time of primary vaccination.

At the start of the experimentation the calves were bled for serum, and calves in treatment groups were administered a commercial vaccine. All vaccines contained inactivated IBR, BVD, PI-3 and BRS viruses and were purchased from Midwest Veterinary Supply, Des Moines, Iowa. The 5 ml dose of each vaccine was injected into two sites, 2.5 ml intramuscularly in each thigh. Groups and vaccine administered were as follows:

Group A -- Controls, no vaccination

Group B -- ELITE 4, Boehringer Ingelheim Animal Health, Inc., St. Joseph, Missouri

Group C -- Triangle 4, Ft. Dodge Laboratories, Inc., Fort Dodge, Iowa

Group D -- Vira Shield 5, Grand Laboratories, Inc., Larchwood, Iowa

Calves were bled and administered a second dose of the vaccine 32 days later. They were bled again on days 61, 99 and 125 of the experimentation.

Serum was harvested and stored at -20°C until tested for antibodies to the various viruses. Antibody titers were determined by standard microtiter virus neutralization tests conducted with two-fold dilutions of serum.

Table 1. Serum antibody titers to various viruses for all 120 calves at the time of primary vaccination.

	<u>IBR</u>	<u>BVD-1*</u>	<u>BVD-2**</u>	<u>PI-3</u>	<u>BRS</u>
Mean Titer	12.6	155.0	69.3	86.3	40.8
Range of Titters	<2-128	20-1,920	7.5-1,280	2.75-480	<2-480

*Biotype 1

**Biotype 2

Results and Discussion

At the start of the experimentation almost all the calves had detectable antibodies against each of the viruses, but titers were quite variable among the animals (Table 1). The level of residual maternal antibodies was highest to BVD biotype 1 virus and lowest to IBR virus. The presence of detectable antibodies in the serum of most of the calves at this time is an important consideration because there was potential for interference with the vaccines.

Mean antibody responses to IBR virus, BVD virus biotype 1, BVD virus biotype 2, and PI-3 virus in the four groups of calves are presented in Figures 1, 2, 3 and 4, respectively. As expected, antibody titers to each of the viruses declined in the control calves during the period of experimentation. This supports clinical observations of no respiratory disease in these animals during the experiment

and absence of natural infection with any of the viruses. Thirty days following primary vaccination mean antibody titers to all viruses had declined in all groups of calves indicating minimal, if any, humoral response to the vaccines. By 61 days vaccination effects were apparent in some groups of calves. Responses to the IBR component (Figure 1) were somewhat disappointing, but each of the vaccines seemed to have elicited a response in some calves at this time. However, the responses of Group D calves was appreciably better and this effect continued for the duration of the experiment.

Residual maternal antibody titers to BVD virus were high in the calves at the time of primary vaccination and probably influenced the response to the vaccines. As compared with the Group A controls, little if any response was elicited in Group B calves (Figures 2 and 3). Antibody titers to BVD biotype 1 virus in Group C calves at 61 days indicated some response, but the response did not persist (Figure 2). Also, Group C calves failed to respond with an increase in antibody titers to BVD biotype 2 virus (Figure 3). In contrast, the response of Group D calves to both biotypes of BVD virus was clearly discernible at 61 days, and antibody levels remained high during the experimental period.

Maternal antibody levels to PI-3 virus were quite high at the beginning of the experiment. Although there appeared to be a response in some animals in each of the vaccinated groups, mean antibody levels in Groups B and C were essentially equivalent to the Group A controls at the termination of the experiment (Figure 4). Mean antibody

levels in Group D calves were higher than any other group on day 61, and this difference persisted throughout the experimental period.

This experimentation demonstrated that appropriately formulated inactivated virus vaccines do have the potential to overcome suppression by maternal antibodies and induce acquired humoral immunity in young calves. In particular, the Vira Shield 5 vaccine produced by Grand Laboratories induced clearly differentiated antibody responses 61 days following primary immunization which persisted through the following 60 days. The vaccine apparently overwhelmed suppression by moderate levels of maternal antibodies. This was clearly demonstrated in the case of BVD virus. Furthermore, the response was elicited to both biotypes of the virus.

Implications

This experimentation demonstrated that a commercial, inactivated virus vaccine can overcome suppression by maternal antibodies to induce an acquired antibody response. These findings are particularly interesting since they may indicate that young calves can be successfully immunized against several viruses that commonly infect young cattle.

Acknowledgments

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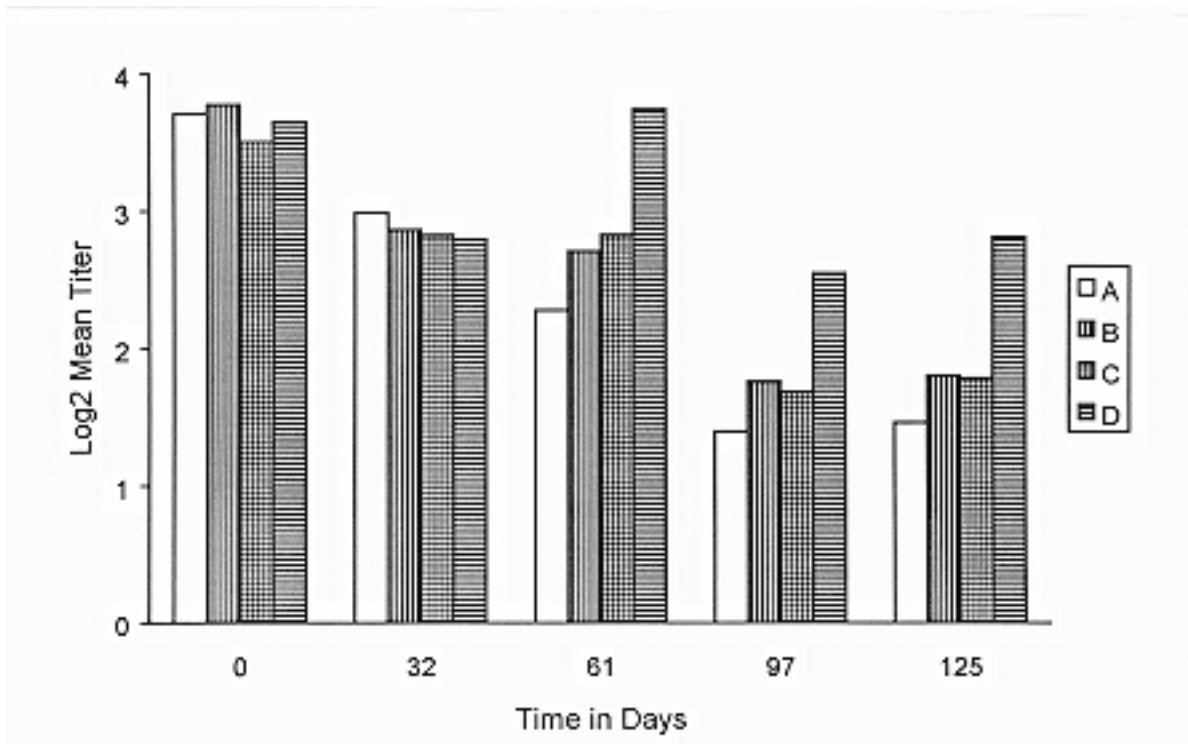


Figure 1. Mean antibody titers to IBR virus in four groups of calves. Calves were left as unvaccinated controls (A) or were vaccinated with one of three commercial inactivated virus vaccines (B,C,D) on days 0 and 32.

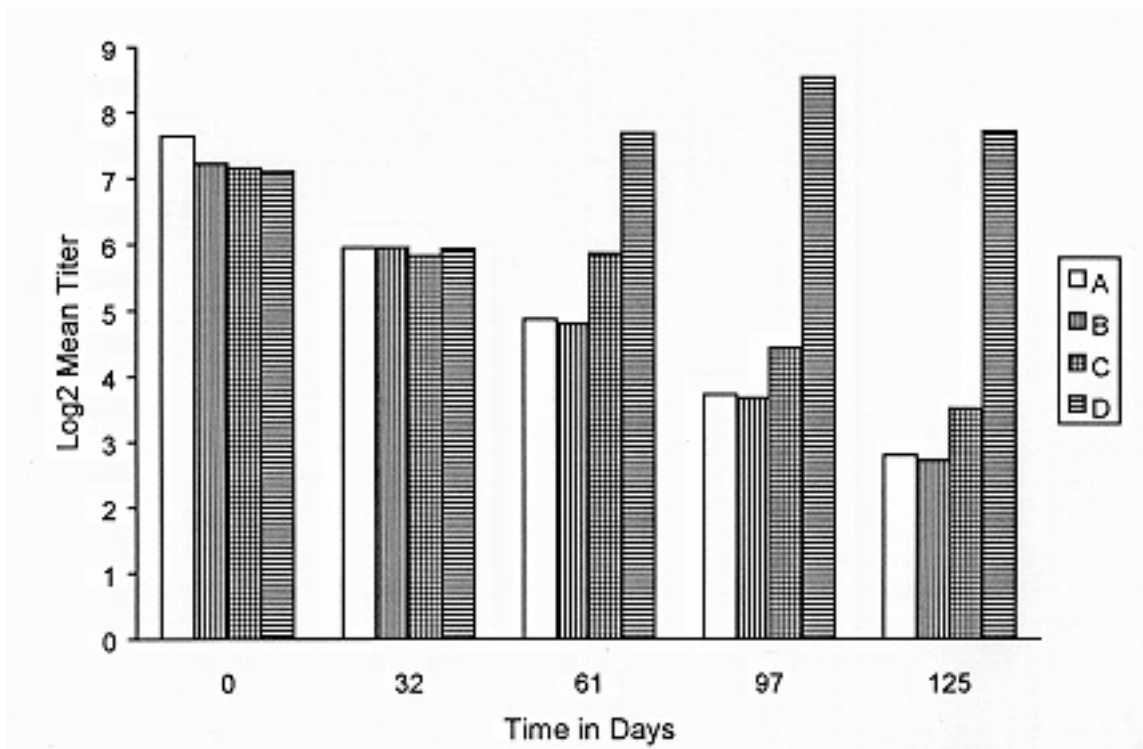


Figure 2. Mean antibody titers to BVD biotype 1 virus in four groups of calves. Calves were left as unvaccinated controls (A) or were vaccinated with one of three commercial inactivated virus vaccines (B,C,D) on days 0 and 32.

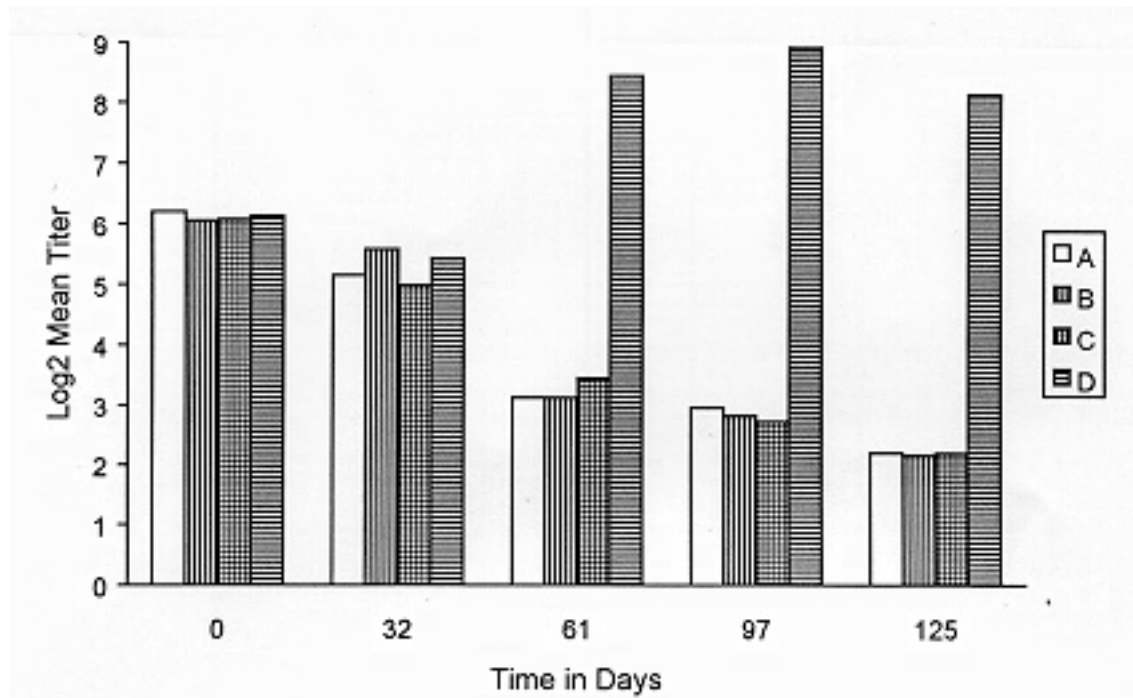


Figure 3. Mean antibody titers to BVD biotype 2 virus in four groups of calves. Calves were left as unvaccinated controls (A) or were vaccinated with one of three commercial inactivated virus vaccines (B,C,D) on days 0 and 32.

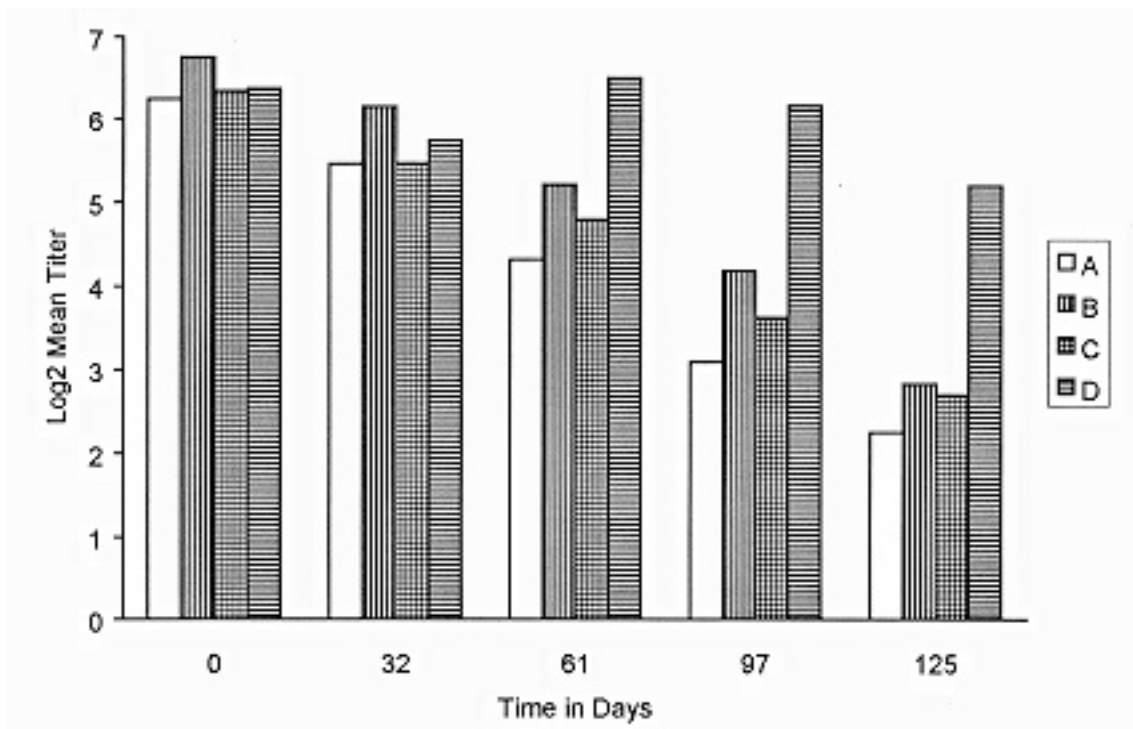


Figure 4. Mean antibody titers to PI-3 virus in four groups of calves. Calves were left as unvaccinated controls (A) or were vaccinated with one of three commercial inactivated virus vaccines (B,C,D) on days 0 and 32.