

Fall 2011

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Recommended Citation

Downum, Whitney; Brown, A. Hayden Jr.; Powell, Jermey G.; Kegley, E. Beth; Johnson, Zelpha B.; Galloway, Doug B.; Hornsby, James A.; and Lindsey, Billy R. (2011) "Calf pre-weaning traits and immunoglobulin response to bovine viral diarrhea virus vaccination," *Discovery, The Student Journal of Dale Bumpers College of Agricultural, Food and Life Sciences*. University of Arkansas System Division of Agriculture. 12:14-18.

Available at: <https://scholarworks.uark.edu/discoverymag/vol12/iss1/5>

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Calf pre-weaning traits and immunoglobulin response to bovine viral diarrhea virus vaccination

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ABSTRACT

Calfhood vaccination for bovine viral diarrhea virus (BVDV) is a relatively new concept, and protocols are evolving. Our objective was to determine effects of BVDV type I vaccination protocol, calf behavior (chute score, and chute exit velocity), and gender on calf gain and immunoglobulin (Ig) response. Crossbred calves (n = 64) were randomly allotted to one of two vaccination protocols. In protocol 1, calves were vaccinated at 60 d of age (d 0) and at weaning (d 147). Calves assigned to protocol 2 were vaccinated against BVDV type I at 21 d prior to (d 126) and at weaning (d 147). Blood samples were collected from half of the calves in each protocol group on d 0 (60 days of age), d 21, d 126 (21 days prior to weaning), and d 147 (at weaning); serum was harvested and Ig titers were determined. Titers for BVDV type I were transformed (log base 2) and analyzed using a mixed model procedure. Calves vaccinated at d 0 and weaning had larger ($P < 0.0001$) titers than calves vaccinated at d 126 and weaning (7.5 ± 0.36 and 5.1 ± 0.36 , respectively). Mean BVDV titers were larger ($P < 0.0001$) on d 147 when compared with d 126, d 21, and d 0 (8.3 ± 0.39 , 5.1 ± 0.40 , 5.9 ± 0.39 and 5.7 ± 0.39 , respectively). A treatment \times day interaction ($P < 0.0001$) also affected BVDV titers. However, BVDV titers were not affected ($P > 0.05$) by calf gender, chute score, or chute exit velocity. Weaning weight and pre-weaning average daily gain (ADG) were not related to BVDV type I titers. This study indicated that vaccinating beef calves against BVDV was effective in triggering an Ig response. Furthermore, our results suggest that calves should be vaccinated against BVDV type I at 60 d of age for greater disease resistance.

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MEET THE STUDENT-AUTHOR



Whitney Downum

I am from Springdale, Ark., and graduated from Springdale High School in 2007. I started my college career at Northwest Arkansas Community College and graduated with an Associate of Science degree in 2009. After graduation, I transferred to the University of Arkansas with a double major in animal science and poultry science with a pre-veterinarian emphasis. I have a double minor in equine science and agricultural business. I am a member of Alpha Zeta, Pre-Vet, and Mortar Board.

During the spring of 2010, I started working with Dr. A. Hayden Brown, Jr. and Dr. Jeremy Powell on a research project concerning calf temperament and immunoglobulin response. Through this research, I have gained valuable experiences. The research that we conducted has allowed me to compete at the 2010 American Society of Animal Science Southern Section in Corpus Christi, Texas, and at the Gamma Sigma Delta competition at the University of Arkansas.

I plan on applying to a veterinary school in the fall of 2011. I hope to pursue my career choice as a large animal veterinarian.

INTRODUCTION

Bovine viral diarrhea virus (BVDV) is an immunosuppressive, single-stranded, enveloped RNA virus (Ridpath, 2002; Glew and Howard, 2001). It is classified in the *Pestivirus* genus of the family *Flaviviridae* (Bolin and Ridpath, 1998). Since BVDV is an RNA virus it can mutate rapidly, which is why there are several strains, and more to develop (Ridpath, 2002). An immunosuppressive virus causes an infection that weakens the immune system, which then leads to secondary infections from other pathogens.

Bovine viral diarrhea virus has an economic impact not only on the U.S. beef industry, but worldwide (Baker, 1995; Houe, 1999). Larson et al., 2002 reported a loss of \$15.33 to \$20.16 per cow, which impacted the cow-calf segment of the industry. Individual herd outbreaks have estimated losses of a few thousand up to one hundred thousand dollars depending on the herd, with estimated losses at the national level ranging between \$10 and \$40 million dollars per million calvings (Houe, 2003).

Bovine viral diarrhea virus infects a high percentage of cattle on the national level, and can cause a number of clinical diseases ranging from subclinical infection to acute fatal mucosal diseases (MD) (Baker, 1995; Houe, 1995) and various reproductive problems. A BVDV infection during gestation can cause infertility, abortions, stillbirths, abnormalities, weak calves and development of BVDV persistently infected (PI) calves (Van Campen et

al., 2000). If the cow is infected with BVDV between 42 to 120 days of the gestational period, the calves may become persistently infected, which means they will persistently shed the virus and keep the herd infected (Fulton et al., 2005, Van Campen et al., 2000) and cause the greatest impact in the feedlot or replacement heifers (Ridpath, 2002). Fetuses infected with the virus after 125 days of gestation usually are not PI calves.

Excitable temperament has been shown to negatively affect the individual's immune system (Fell et al., 1999) and the cattle industry (Curley et al., 2006). Excitable temperament can compromise immune function making it difficult for the animal to produce a sufficient response when challenged with disease causing organisms (Oliphint et al., 2006). Calves with desirable temperament have greater response to the vaccine (Oliphint et al., 2006). Calfhood vaccinations have increased subsequent growth and decreased subsequent morbidity (Oliphint et al., 2006). Average daily gain (ADG), feed conversion, morbidity, fertility, and beef quality has been shown to be related to temperament (Hoppe et al., 2010). Stimulating a calf's immune system while it still has a high maternal antibody can be beneficial, since the calves will change from maternally derived immunity to long-lasting acquired immunity without experiencing a period of vulnerability before a vaccine can induce protection (Endsley et al., 2003).

Calfhood vaccination for BVDV is a relatively new concept; additional research seems appropriate. The purpose

of this study was to determine the effects of treatment, calf age, and age of dam on immunoglobulin (Ig) response to BVDV vaccination and to determine the relationship of Ig response with chute behavior score (CS), chute exit speed (CES), weaning weight, and pre-weaning ADG in crossbred beef calves.

MATERIALS AND METHODS

Crossbred calves ($n = 64$) were Angus sired, born in the spring, and weaned in the fall. The cows were Angus based, but not straightbred. The group of calves tested averaged 60 days of age and was located at the Savoy research unit at the start of the trial. The calves were stratified by date of birth, gender (heifers or steers [castrated at birth]), and age of cow then assigned randomly to one of two treatment groups resulting in 32 calves in each treatment. All calves were tested using Pyramid 5 vaccine (Boehringer-Ingelheim Vetmedica, St. Joseph, Mo.) which includes BHV, BVDV (Type I and II), PI3, and BRSV. All calves were tested for PI BVDV using the AC-ELISA procedure (CattleStats, Oklahoma City, Okla.) at branding.

Calf temperament or chute score (CS) was evaluated on a scale of 1-5 where 1 is extremely docile and 5 is berserk frenzy. Calves were then assigned a score of 1-5 to designate behaviors using the following five-point temperament rating system, similar to that which Grandin (1998) used: 1—calm, no movement, extremely docile; 2—restless shifting, slightly nervous; 3—squirring, continuous shaking of chute, down on foreknees; 4—rearing, twisting, continuous violent struggle, back and forward movement; and 5—berserk frenzy.

Serum from jugular samples taken on d 0 (60 d of age), d 21, d 126 (21 d prior to weaning), and d 147 (at weaning) from half of the calves in each group (approximately 16 calves) was harvested for determination of Ig response (Table 1). Blood was collected via jugular venipuncture in an evacuated tube. Serum was sent to Iowa State University Veterinary Diagnostic Laboratory (Iowa State University, Ames, Iowa) for measurement of Ig response using viral neutralization.

Chute exit velocity (CEV) was calculated as velocity = distance (m)/time (s). The CEV of the calf was measured electronically (Polaris Wireless Timer; FarmTek, Inc.; Wylie, Texas) over a 1.8-m distance beginning 1.8 m in front of the head gate. To trigger the starting and stopping of the timer, infrared sensors were used. Chute exit velocity was calculated on d 147 of the trial.

Calves were weighed on d 0, d 21, d126, and d 147 of the trial to determine pre-weaning ADG, and weaning weight was taken on d 147 of the trial.

Statistical Analysis. Titer data were transformed to log base 2 (\log_2). Data were analyzed using mixed model pro-

cedures of SAS (SAS Inst. Inc., Cary, N.C.). Fixed effects were treatment, sex, and date. Calf was a random effect. Chute score (CS), chute exit velocity, weaning weight, and pre-weaning ADG were analyzed using CORR procedures of SAS. Means were separated with PDIFF option of SAS.

RESULTS AND DISCUSSION

The least square means of CS and CEV by treatments did not have a significant change. In treatment 1, calves had an average CS of $1.60 \text{ m/s} \pm 0.171$ and a CEV of $2.26 \text{ m/s} \pm 0.241$; while calves in treatment 2 had an average CS of $1.63 \text{ m/s} \pm 0.171$ and a CEV of $2.69 \text{ m/s} \pm 0.254$. The least square means of CS and CEV by sex did not have a significant change. Heifers had an average CS of $1.53 \text{ m/s} \pm 0.172$ and a CEV of $2.31 \text{ m/s} \pm 0.251$. While steers had an average CS of $1.70 \text{ m/s} \pm 0.178$ and a CEV of $2.64 \text{ m/s} \pm 0.255$. A treatment \times day interaction ($P < 0.0001$) was found for mean \log_2 of BVDV Type I titer. Mean \log_2 of BVDV Type I titer were not affected ($P > 0.05$) by sex, CEV, CS, age of dam, weaning weight, and pre-weaning ADG.

Calves in treatment 1 were vaccinated against BVDV using Pyramid 5 vaccine on d 0 and d147, while calves in treatment 2 were vaccinated on d 126 and d 147 of the trial. On d 0 and d 21 of the trial, both treatments showed high maternal antibody titers. On d 126, calves in treatment 1, which had previously been vaccinated, continued to show high serum titers, while treatment 2 titers declined at that time. On d 147 of the trial, both treatments showed an increase in high serum titers (Table 2). Vaccination of beef calves with modified-live virus vaccine at 67 days of age was effective in an immunological response (Kirkpatrick et al., 2008).

Vaccinating beef calves at 60 d of age (d 0 of the study) against BVDV was effective in triggering an Ig response. Bovine viral diarrhea virus vaccination had no effect on other production parameters that were studied. Calves should be vaccinated against BVDV Type I at 60 d of age for greater disease resistance.

ACKNOWLEDGEMENTS

I would like to thank Dr. Brown for his encouragement, advice, and support in this project. Thanks to Dr. Powell for his help and explanation of the project. Gratitude is also extended to the Sugar Hills and Dale Bumpers College of Agricultural, Food and Life Sciences for their financial funding of my project.

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Table 1. Experimental design of treatments, vaccination times, and blood collection times (n = 16) during the 147-d study.

Treatment	60 days of age ^z		21 days prior to weaning	Weaning
	d 0 May 6	d 21 May 27	d 126 September 9	d 147 September 30
1	Vaccinated for BVDV (Pyramid 5)	Blood collected for titer response	Blood collected for titer response	Vaccinated for BVDV (Pyramid 5)
	Blood collected for titer response			Blood collected for titer response
2	Blood collected for titer response	Blood collected for titer response	Vaccinated for BVDV (Pyramid 5)	Vaccinated for BVDV (Pyramid 5)
			Blood collected for titer response	Blood collected for titer response

^z Day (d) 0 = 60 days of age.

Table 2. Least square means of log 2 type I titer for treatment x day interaction.

Treatment	Day ^z	Mean Log ₂ BVDV type I titer
1	0	4.95 ± 0.56d ^y
	21	6.19 ± 0.56bc
	126	9.30 ± 0.56a
	147	9.45 ± 0.55a
2	0	6.48 ± 0.55bc
	21	5.69 ± 0.55ad
	126	0.99 ± 0.56e
	147	7.11 ± 0.56b

^z Day (d) 0 = 60 days of age.

^y Means with different letters differ ($P < 0.05$).