Effect of Respiratory Disease Vaccination Program on Immune Response in Beef Calves

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Story in Brief

Sixty autumn-born Angus steer and heifer calves at the Beef Cattle Research Facility in Savoy, AR, were stratified in late May 2002 by weight and sex into two treatment groups: 1) Elite-4™, Pulmo-guard™ PHM-1 and Caliber™ 7 followed 3 weeks later at weaning by Express-5™ and Caliber™ 7 and 2) CattleMaster® 4, One Shot , and Caliber™ 7 followed at weaning by Bovi-Shield™ 4 and Caliber™ 7 to compare calf immune responses. Blood samples were collected from calves on d 0 when preweaning vaccinations were administered, d 21 when weaning vaccinations were administered and d 51 (30 d post-weaning). Analyses were performed to determine serum antibody titers to infectious bovine rhinotracheitis, bovine viral diarrhea type I, bovine viral diarrhea type II and bovine respiratory syncytial virus. Results from this study indicate that both vaccination programs were effective in boosting ($P < 0.01$) calf antibody titers to infectious bovine rhinotracheitis, bovine viral diarrhea type II and bovine respiratory syncytial virus.

Introduction

Bovine respiratory disease complex (BRD), also known as shipping fever or bronchopneumonia, is associated with significant economic losses resulting from morbidity and mortality in newly weaned or received cattle. Factors contributing to the incidence of BRD include stress, nutrition, immunity, and exposure to infectious pathogens. Viral agents commonly involved in pathogenesis of BRD include infectious bovine rhinotracheitis (IBR), bovine viral diarrhea (BVD), bovine respiratory syncytial virus (BRSV), and parainfluenza³ (PI³). Implementation of preweaning respiratory disease vaccination programs may result in heavier weaning calves (Coffey et al., 1999), enhance the immune status of newly weaned calves (Galyean et al., 1999), and decrease post-weaning BRD. Cattle administered a modified-live viral vaccine prior to feedlot entry may also exhibit a lower occurrence of respiratory tract lesions (Grathwohl et al., 2001). Results from the Arkansas Feedout Program indicate that sickness in the feedlot can reduce a calf's ability to grade Choice (Troxel et al., 2001). The objectives of this study were to compare immune responses of beef calves administered either 1) Elite-4™, Pulmo-guard™ PHM-1 and Caliber™ 7 preweaning with Express-5™ and Caliber™ 7 boosters at weaning or 2) CattleMaster® 4, One Shot®, and Caliber™ 7 preweaning with Bovi-Shield™ 4 and Caliber™ 7 boosters at weaning.

Experimental Procedures

Sixty Angus calves born in autumn 2001 at the Beef Cattle Research Facility in Savoy, AR, grazed mixed forage pastures with their dams. On May 28, 2002, calves on these pastures were stratified by weight and sex into two treatment groups to compare respiratory disease vaccination protocols (Table 1). Group I received vaccinations of Elite-4™ (Boehringer Ingelheim Vetmedica, Inc.), Pulmo-guard™ PHM-1 (Boehringer Ingelheim Vetmedica, Inc.) and Caliber™ 7 (Boehringer Ingelheim Vetmedica, Inc.) followed at weaning by Express-5™ (Boehringer Ingelheim Vetmedica, Inc.) and Caliber™ 7. Group II received CattleMaster® 4 (Pfizer Animal Health), One Shot® (Pfizer Animal Health) and Caliber™ 7 followed at weaning by Bovi-Shield™ 4 (Pfizer Animal Health) and Caliber™ 7. Elite-4™ contained killed IBR, PI³, BRSV, and BVD viruses, while CattleMaster® 4 was comprised of chemically altered strains of IBR and PI³ viruses, modified live BRSV, and killed cytopathic and noncytopathic BVD virus strains using an aluminum hydroxide adjuvant. Express-5™ and Bovi-Shield™ 4 each contained modified live strains of IBR, PI³, BRSV, and BVD viruses. Pulmo-guard™ PHM-1 was a bacterin-toxoid vaccine used to prevent *Pasteurella haemolytica* and *P. multocida* infection, while One Shot® was a bacterin-toxoid vaccine used to prevent *P. haemolytica* type A1 infection. Caliber™ 7 was labeled for vaccination against disease caused by *Clostridium chauvoei*, *C. septicum*, *C. novyi*, *C. sordellii*, and *C. perfringens* types C and D.

Suckling steer and heifer calves with no previous exposure to respiratory disease vaccination received initial vaccinations on May 28, 2002 (d 0) and 3 weeks prior to weaning. Thirty calves were on each vaccination protocol. Booster vaccinations of Bovi-Shield™ 4, Express-5™, and Caliber™ 7 were administered at weaning on June 18, 2002 (21 d following the initial vaccinations). Elite-4™, CattleMaster® 4, Bovi-Shield™ 4, and Express-5™ were administered intramuscularly in the neck region, while Pulmo-guard™ PHM-1, One Shot®, and Caliber™ 7 were administered subcutaneously in the neck region in compliance with Beef Quality Assurance guidelines. In accordance with product label recommendations, the dosage for Elite-4™ was 5 ml per injection, while the dosages for CattleMaster® 4, Pulmo-guard™ PHM-1, One Shot®, Caliber™ 7, Express-5™, and Bovi-Shield™ 4 were 2 ml per injection. Blood samples and calf weights were collected from each animal on d 0 prior to initial vaccination, d 21 prior to weaning vaccination, and d 51. An interim weight was also taken on July 2, 2002 (d 34). Approximately 7 ml of blood was collected from each calf via jugular venipuncture. Blood samples were centrifuged at 2000 rpm for 20 min to separate and harvest serum that was stored at -4°F until assayed. Analysis was performed to determine serum antibody titers to the four respiratory viruses.

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Statistical analysis. This experiment utilized a completely randomized design. The GLM procedure of SAS (SAS Inst., Inc., Cary, NC) was used to determine the effects of treatment, calf sex, and interactions. Titer data were tested for normality with the Shapiro-Wilk test. The null hypothesis was rejected ($P < 0.01$) for all titer variables. Because the titer data were not normally distributed, the variations around the means are not reported. Titer data were transformed to a natural logarithm before analysis. Non-transformed least-squares means are reported.

Results and Discussion

Calf ADG results are presented in Table 2. For the weigh period of June 18 to July 2, steers in the Group II vaccination program had greater ADG than steers in the Group I and heifers in the Group II vaccination programs, while there were no differences in ADG ($P > 0.10$) for heifers between the two vaccination programs (Interaction, $P < 0.02$). There were no other differences observed in ADG ($P > 0.10$) between steers and heifers or between treatment groups.

Serum antibody titer levels appear in Table 3. Antibody titers to IBR were higher ($P < 0.10$) in heifers than steers on day 0, however, no other titer differences were found between steers and heifers. Between day 21 and d 51 IBR antibody titers increased ($P < 0.01$) and BVD Type II antibody titers increased ($P < 0.01$) for both treatments. On day 51 IBR antibody titers were higher ($P < 0.01$) in both steer and heifer calves in Group II. Bovine viral diarrhea Type I ($P < 0.05$) and BVD Type II ($P < 0.01$) antibody titers were higher on day 51 in calves in Group I. In addition, BRSV antibody titers increased ($P < 0.01$) in both treatment groups from day 0 to day 21. On days 21 and 51, BRSV antibody titers were higher ($P < 0.01$) in both steer and heifer calves in Group II.

These results indicate that both respiratory disease vaccination protocols were successful in elevating antibody titers to viral agents commonly involved in BRD development including IBR, BVD Type I, BVD Type II, and BRSV. In addition, booster vaccinations at weaning were effective in increasing antibody titers to IBR and BVD Type II beyond initial titer response to preweaning vaccinations in both treatment groups. This illustrates the importance of booster vaccinations in these vaccination protocols. At 30 d post-weaning, the calves in Group I had an advantage in antibody titer levels for BVD Types I and II, while the calves in Group II had an advantage in antibody titer levels for IBR. There was, however, no demonstrated overall benefit of one vaccination protocol over the other in terms of calf weight gains.

Implications

Cow-calf producers have several preweaning vaccination program options that are effective in boosting antibody titers and calf immune response against major bovine respiratory disease viruses. Utilizing such a program may have benefits for not only cow-calf producers, but also producers involved in post-weaning phases of beef production.

Literature Cited

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Table 1. Treatment, bleeding and weighing schedule.

Sampling date	Group I	Group II
Preweaning	Elite-4™	CattleMaster® 4
May 28, 2002	Pulmo-guard™ PHM-1	One Shot ®
(d 0)	Caliber™ 7	Caliber™ 7
	Blood sample	Blood sample
	Weight	Weight
Weaning	Express-5™	Bovi-Shield™ 4
June 18, 2002	Caliber™ 7	Caliber™ 7
(d 21)	Blood sample	Blood sample
	Weight	Weight
July 2, 2002	Weight	Weight
(d 34)		
Post-Weaning	Blood sample	Blood sample
July 18, 2002	Weight	Weight
(d 51)		

Table 2. Average daily gains of steer and heifer calves on different respiratory disease vaccination protocols.

	Average daily gain, lb					
	Steers		Heifers		All calves	
Weigh period[a]	Group I[b]	Group II[b]	Group I	Group II	Group I	Group II
May 28 to June 18	0.86 ± 0.12	1.07 ± 0.12	0.95 ± 0.12	0.85 ± 0.11	0.90 ± 0.08	0.96 ± 0.08
June 18 to July 2[c]	0.75± 0.10[e]	1.16 ± 0.10[d]	0.95 ± 0.09[de]	0.87 ± 0.09[e]	0.86 ± 0.07	1.01 ± 0.07
July 2 to July 18	1.44 ± 0.23	1.41 ± 0.23	1.32 ± 0.22	1.25 ± 0.21	1.38 ± 0.16	1.32 ± 0.15
May 28 to July 18	0.95 ± 0.11	1.21 ± 0.11	1.05 ± 0.10	0.97 ± 0.10	1.00 ± 0.07	1.09 ± 0.07

[a] May 28, 2002: initial vaccinations administered, blood samples and weights collected; June 18, 2002: booster vaccinations administered, blood samples and weights collected, calves weaned; July 2, 2002: weights collected; July 18, 2002: blood samples and weights collected.

[b] Group I received Elite-4TM, Pulmo-guardTM PHM-1, CaliberTM 7 21 d prior to weaning and Express-5TM and CaliberTM 7 at weaning. Group II received CattleMaster ® 4, One Shot ® and CaliberTM 7 21 d prior to weaning and Bovi-ShieldTM 4 and CaliberTM 7 at weaning.

[c] Calf sex x treatment, $P < 0.02$.

d,e Within a row, within steers and heifers or within all calves, means with different superscripts differ, $P < 0.05$. In the absence of superscripts, means within a row are not different.

Table 3. Bovine rhinotracheitis (IBR), bovine viral diarrhea (BVD) Type I, BVD Type II, and bovine respiratory syncytial virus (BRSV) titers of steer and heifer calves on different respiratory disease vaccination protocols.

Sampling	Titer levels					
date, d	Steers		Heifers		All calves	
	Group I[a]	Group II[a]	Group I	Group II	Group I	Group II
IBR						
0[b]	2.8	2.1	11.2	3.9	7.0	3.0
21[c]	38.1	38.3	38.0	43.3	38.1	40.8
51	71.1[g]	144.0[f]	64.5[g]	120.0[f]	67.8[g]	132.0[f]
BVD Type I						
0	2117.3	3630.9	2410.7	3076.0	2264.0	3353.4
21	4219.7	4315.4	4966.4	4896.0	4593.1	4605.7
51	7606.9[h]	6729.1[i]	8192.0[h]	6528.0[i]	7899.4[h]	6628.6[i]
BVD Type II						
0	18.9	2.0	10.8	2.0	14.9	2.0
21[d]	18.9	2.4	6.1	2.4	12.5	2.4
51	274.9[f]	94.3[g]	246.4[f]	98.6[g]	260.6[f]	96.5[g]
BRSV						
0[e]	4.1	3.4	3.6	4.1	3.9	3.8
21	9.1[g]	67.1[f]	8.1[g]	53.0[f]	8.6[g]	60.1[f]
51	8.4[g]	45.2[f]	11.7[g]	48.5[f]	10.1[g]	46.9[f]

[a] Group I received Elite-4TM, Pulmo-guardTM PHM-1, CaliberTM 7 21 d prior to weaning and Express-5TM and CaliberTM 7 at weaning. Group II received CattleMaster ® 4, One Shot ® and CaliberTM 7 21 d prior to weaning and Bovi-ShieldTM 4 and CaliberTM 7 at weaning.

[b] Main effects for calf sex differ: IBR, $P < 0.10$.

[c,d,e] Means change across sampling periods due to treatment effects: c: d 21 to d 51, $P < 0.01$; d: d 21 to d 51, $P < 0.01$; e:d 0 to d 21, $P < 0.01$.

[f,g] Within a row, within steers and heifers or within all calves, means with different superscripts differ, $P < 0.01$. In the absence of superscripts, means within a row are not different.

[h,i] Within a row, within steers and heifers or within all calves, means with different superscripts differ, $P < 0.05$. In the absence of superscripts, means within a row are not different.