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K-STATE Research and Extension

CATTLEMEN'S DAY 2025

KANSAS STATE UNIVERSITY CATTLEMEN'S DAY

Evaluation of Calcidol (25(OH)D_3) or Combination of Calcidol and Beta-Carotene on Feed Intake, Growth Performance, and Health in High-Risk, Newly Received Beef Heifers

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Abstract

Calcidol supplementation can improve immune function in transitioning dairy cattle. The objective was to determine if supplemental calcidol [25(OH)D_3] at varying levels would affect feed intake, growth performance, and health of high-risk, newly received beef cattle. A total of 480 crossbred heifers were assembled around Dickson, TN, and shipped to Manhattan, KS. Heifers were weighed individually upon arrival. On the day following arrival, heifers were stratified within block by arrival weight to one of eight pens containing 12 heifers each. Cattle were limit-fed at 2.2% of body weight (BW) for 56 days. Pens were assigned one of four treatments: 1) 3,000 IU/head/day added vitamin D_3 (Control); 2) 0.5 mg/head/day calcidol; (HyD, DSM Nutritional Products, Plainsboro, NJ; HyD Low); 3) 1.0 mg/head/day calcidol (HyD High); or 4) 1.0 mg/head/day calcidol and 100 mg beta-carotene (Victus Transition; DSM Nutritional Products, Plainsboro, NJ; HyD + BC). Treatments were top-dressed daily. Pen weights were measured every 14 days to adjust feed offered the following 14 days. Individual BW were measured on days 0, 14, 28, and 56. Final BW, average daily gain, gain:feed, and dry matter intake did not differ ($P \geq 0.36$) among treatments. Overall prevalence of respiratory morbidity and mortality was 56.25% and 1.46%. No treatment differences were detected for first, second, or third respiratory morbidity or mortality ($P \geq 0.16$). Heifers fed HyD High had greater ($P < 0.001$) serum 25(OH)D_3 concentrations compared with heifers fed HyD Low at days 14, 28, and 56. At days 14, 28, and 56, all heifers supplemented with HyD (HyD Low, HyD High, HyD + BC) had greater ($P < 0.001$) serum 25(OH)D_3 concentrations compared with heifers fed Control. Overall, supplementation with calcidol or a combination of calcidol and beta-carotene did not affect feed intake, growth performance, or health of high-risk, newly received heifers.

Introduction

Vitamin D is critical to the normal development and growth of all cattle. Recent reports have shown a positive role for vitamin D in immune function of dairy cattle. Calcidol

[1] DSM Nutritional Products, Plainsboro, NJ

is a metabolite of vitamin D metabolism. It can be used to prevent and treat vitamin D deficiency. Calcidol supplementation improves health and immune function in transition dairy cows, and beta-carotene (antioxidant) helps to improve immune function in dairy calves. High-risk receiving cattle are subjected to a wide variety of stressors, such as commingling, transportation, disease exposure, and low feed intake. Because calcidol and beta-carotene supplementation help to mitigate stress-induced immune responses in dairy cattle at different phases, we hypothesized it would provide similar benefits to receiving beef cattle. The objective of this study was to evaluate the effects of feed intake, growth performance, and health when calcidol [25(OH)D_3] or a combination of calcidol and beta-carotene is supplemented in newly received growing beef heifers.

Experimental Procedures

A total of 480 crossbred heifers (BW = 500 ± 35 lb) were purchased at auction markets around Tennessee, assembled at an order buyer's facility in Dickson, TN, and then shipped 674 miles to the Kansas State University (KSU) Beef Stocker Unit over a 9-day period from October 4 to October 12, 2023. Cattle were weighed immediately upon arrival at KSU, individually identified with a visual and electronic identification tag, and an ear notch sample was taken for testing of persistent infection with bovine viral diarrhea virus. Four animals tested positive (two - HyD Low and two - HyD High) and were removed from the experiment.

Following initial processing, heifers were offered prairie hay at 1% of BW (dry matter (DM) basis), had *ad libitum* access to water, and were allowed to stand overnight. The following day (day 0), calves were individually weighed, treated for internal (Safeguard; Merck Animal Health, Madison, NJ) and external (Clean-Up II; Elanco, Greenfield, IN) parasites, vaccinated for respiratory (Titanium 5; Elanco, Des Moines, IA) and clostridial (Bovilus Vison 7 with somnus; Merck Animal Health, De Soto, KS) disease, given metaphylaxis treatment (Tulieve; Norbrook, Newry, IRE), and assigned a pen tag.

When processing was complete, heifers were allocated to their respective treatment pens. Treatments included: 1) 3,000 IU/head/day added vitamin D_3 (Control); 2) 0.5 mg/head/day calcidol; (HyD, DSM Nutritional Products, Plainboro, NJ; HyD Low); 3) 1.0 mg/head/day calcidol (HyD High); or 4) 1.0 mg/head/day calcidol and 100 mg beta-carotene (Victus Transition; DSM Nutritional Products, Plainsboro, NJ; HyD + BC). A common limit-fed experimental diet (Table 1) was offered at 2.2% of BW daily (DM basis). Treatments were top-dressed at feeding daily.

Throughout the trial, heifers were observed once daily for clinical signs of respiratory illness. Respiratory illness was treated as follows: first treatment was florfenicol, second treatment was enrofloxacin, and third treatment was oxytetracycline. Heifers requiring a third treatment were declared as chronic and removed from the experiment. During the trial, seven total animals were found dead in the pen from bronchopneumonia (one – Control; two - HyD Low; two - HyD High; and two - HyD + BC). Additionally, three heifers were removed for lameness injury (one - Control; one- HyD High; and one - HyD + BC) and 34 chronic pneumonias were removed from the study (seven - Control; seven - HyD Low; nine - HyD High; and eleven - HyD + BC). Data from these heifers were excluded from the analysis.

Blood samples were taken via jugular vein with 18-gauge needles from heifers on arrival (day 0) and on days 14, 28, and 56. Blood was collected into an 8.5 mL serum separator blood tube for analysis of serum 25(OH)D_3 concentrations. Samples were frozen at

-4°F until analysis by High Performance Liquid Chromatography coupled with tandem mass spectrometry (DSM Nutritional Products, Belvidere, NJ). Data were analyzed as a randomized complete block design using the MIXED procedure of SAS (version 9.3; SAS Institute, Cary, NC). Pen was the experimental unit. In the statistical model, treatment was a fixed effect, and block was a random effect. Treatment differences were considered significant at *P*-value less than 0.05 and tendencies at *P*-value less than 0.10.

Results and Discussion

Performance data are presented in Table 2. Final BW, average daily gain, gain:feed, and dry matter intake did not differ ($P \geq 0.36$) among treatments. Serum data are presented in Table 3. Heifers fed HyD High had greater ($P < 0.001$) serum 25(OH)D_3 concentrations than calves fed HyD Low at days 14, 28, and 56. At days 14, 28, and 56, all calves supplemented with HyD (HyD Low, HyD High, and HyD + BC) had greater ($P < 0.001$) serum 25(OH)D_3 concentrations compared with calves fed Control. Overall prevalence of respiratory morbidity and mortality were 54.6% and 1.45%, respectively. No treatment differences ($P \geq 0.16$) were detected for first, second, or third respiratory morbidity or mortality; however, many heifers were treated in the first 14 days of the trial. High respiratory morbidity early in the feeding period coupled with low concentrations of circulating 25-hydroxyvitamin D_3 could explain why there was no statistical significance in performance and health. Future research is needed in evaluating calcidol supplementation early in the receiving period to elevate circulating 25-hydroxyvitamin D_3. Overall, supplementation with calcidol or a combination of calcidol and beta-carotene did not affect feed intake, growth performance, or health of high-risk, newly received heifers.

Implications

Overall, this study showed that the supplementation of calcidol [25(OH)D_3] or calcidol and beta-carotene did not improve feed intake, growth performance, or health in high-risk, newly receiving beef cattle; however, calcidol [25(OH)D_3] supplementation in the diet increased serum concentrations of 25(OH)D_3.

Table 1. Composition of experimental diets fed to high-risk beef heifers

	Dietary Treatment[1]			
Item	**Control**	**HyD Low**	**HyD High**	**HyD + BC**
Ingredient, % dry matter				
Whole corn	39.5	39.5	39.5	39.5
Supplement[2]	7.5	-	-	-
Supplement[3]	-	7.5	7.5	7.5
Wet corn gluten feed[4]	40.0	40.0	40.0	40.0
Prairie hay	13.0	13.0	13.0	13.0
Nutrient composition, % dry matter				
Dry matter	77.9	77.9	77.9	77.9
Crude protein	13.6	13.6	13.6	13.6
Organic matter	94.5	94.6	94.6	94.6
Neutral detergent fiber	25.2	25.3	25.3	25.3
Acid detergent fiber	14.0	13.7	13.7	13.7

[1] Control = 3,000 IU/head/day added vitamin D_3; HyD Low = 0.5 mg/head/day calcidol; HyD High = 1.0 mg/head/day calcidol; HyD + BC = 1.0 mg/head/day calcidol and 100 mg beta-carotene.
[2] Supplement pellet formulated to contain (dry matter basis) 7.5% calcium, 4.7% salt, 6,000,000 IU vitamin D_3/ton, and 10.8 oz/ton monensin (Rumensin 90; Elanco, Greenfield, IN).
[3] Supplement pellet formulated to contain (dry matter basis) 7.5% calcium, 4.7% salt, and 10.8 oz/ton monensin (Rumensin 90; Elanco, Greenfield, IN).
[4] Sweet Bran, Cargill Corn Milling, Blair, NE.

Table 2. Effects of calcidol (25-OH-D_3) supplementation on feed intake and growth performance of limit-fed growing heifers

	Dietary Treatment[1]					
Item	Control	HyD Low	HyD High	HyD + BC	SEM[2]	*P*-value
Number of pens	10	10	10	10	--	--
Number of animals[3]	111	109	106	106	--	--
Body weight, lb						
Day 0	498	498	501	498	2.7	0.88
Day 56	650	642	637	639	7.3	0.54
Average daily gain, lb/day						
Day 0 to 56	2.71	2.58	2.47	2.51	0.059	0.40
Dry matter intake, lb/day						
Day 0 to 56	12.08	11.84	11.86	11.82	0.113	0.36
Gain:feed, lb/lb						
Day 0 to 56	0.225	0.212	0.209	0.212	0.0043	0.53
Morbidity, %						
Treated once	50.00	58.33	53.33	63.33	0.276	0.17
Treated twice	13.33	16.67	15.83	25.83	0.408	0.34
Treated thrice	5.83	5.83	7.50	9.17	0.625	0.83
Mortality, %	0.83	1.67	1.67	1.67	1.045	1.00

[1] Control = 3,000 IU/head/day added vitamin D_3; HyD Low = 0.5 mg/head/day calcidol; HyD High = 1.0 mg/head/day calcidol; HyD + BC = 1.0 mg/head/day calcidol and 100 mg beta-carotene.
[2]Standard error of the mean.
[3]Performance data from dead and chronic heifers were removed from analysis.

Table 3. Serum 25-hydroxyvitamin D_3 concentrations and beta-carotene of crossbred growing heifers relative to dietary treatment

	Dietary Treatment[1]					*P*-value		
Item	Control	HyD Low	HyD High	HyD + BC	SEM[2]	Treatment	Day	Treatment × Day
Number of pens	10	10	10	10	---	---	---	---
Number of animals[3]	113	109	106	104	---	---	---	---
Serum 25-hydroxyvitamin D_3, ng/mL								
Day 0	21.57	26.45	24.09	23.00	7.41	<0.001	<0.001	0.586
Day 14	23.35	105.79	183.76	167.30	7.41	<0.001	<0.001	<0.001
Day 28	40.11	118.85	184.62	185.08	7.41	<0.001	<0.001	<0.001
Day 56	38.36	134.82	191.48	196.22	7.41	<0.001	<0.001	<0.001
Beta-carotene, mg/L								
Day 0	4.944	---	---	4.420	0.189	<0.001	<0.001	0.042
Day 14	1.018	---	---	1.470	0.189	<0.001	<0.001	0.078
Day 28	0.667	---	---	1.525	0.189	<0.001	<0.001	0.001
Day 56	0.516	---	---	1.874	0.189	<0.001	<0.001	<0.001

[1] Control = 3,000 IU/head/day added vitamin D_3; HyD Low = 0.5 mg/head/day calcidol; HyD High = 1.0 mg/head/day calcidol; HyD + BC = 1.0 mg/head/day calcidol and 100 mg beta-carotene.
[2]Standard error of the mean.
[3]Serum data from dead and chronic heifers were removed from analysis.