PERFORMANCE OF YOUNG CALVES SUPPLEMENTED WITH VITAMINS C AND E AND BETA-CAROTENE

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Summary

Newborn Holstein calves were used to investigate responses to supplemental antioxidants provided in daily milk allotments. Treated calves assigned to receive daily 100 IU of d-alpha tocopherol (vitamin E), 5 mg of beta-carotene, and 500 mg of ascorbic acid (vitamin C) in a 5-ml carrier. Control calves received the carrier alone. Additional vitamins C and E and beta carotene did not affect weaning age, weekly or total body weight gain, or dry feed intake. Supplementation of these antioxidants affected bull and heifer calves scour scores differently at different birth weights. Antioxidant supplementation increased the severity of scours during the first week for bull and heifer calves and the second week for bull calves but decreased the severity for heifer calves during the second week.

(Key Words: Antioxidants, Calf Performance, Scours Scores.)

Introduction

Researchers have reported that the antioxidants vitamin C, vitamin E, and beta-carotene enhance immune functions and decrease the severity of scours. Supplemental antioxidants may help overcome stresses to which newborn calves may be subjected, including poor housing environment, extended transportation, and changing environmental conditions. During incidents of disease or other stressful situations, requirements for antioxidants can exceed concentrations required for growth.

Vitamins C and E and beta-carotene appear to interact with each other. Vitamin C regenerates vitamin E, and beta-carotene complements vitamin E and has been shown to increase immunocompetance. Only a limited understanding exists of the interrelationship of these antioxidants when all three are supplemented together. Our objective was to monitor production responses of newborn calves when supplemented with a combination of vitamins C and E and beta-carotene.

Procedures

Forty newborn Holstein calves (25 bulls and 15 heifers) from the Kansas State University dairy herd were used during the fall of 1994 and early winter of 1995. Calves received colostrum soon after birth and transition milk for 2 more days, then were moved to individual hutches bedded with straw and remained there for the 8-wk experiment.

Calves were blocked by age and sex, and calves within blocks were assigned randomly to either a control or treatment group. All calves received daily milk at 8% of initial body weight, divided into two equal feedings. Treated calves received daily an antioxidant combination (Bioglan, Inc., Laguna, CA) that contained 100 IU of d-alpha tocopherol, 5 mg of beta-carotene, and 500 mg of ascorbic acid in 5 ml of carrier. The control group received only the carrier. The supplements were mixed with the afternoon feeding of milk until the calves were weaned. Calf starter (Table 1) was available to all calves in amounts comparable to daily consumption to ensure availability of fresh feed and ad libitum intake. Water was

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always available when ambient temperature was above freezing and twice daily for at least 1 hr when temperature was below freezing.

Calves were weaned when dry feed intake exceeded 1.5 lb per day for 3 consecutive days; they had gained greater than or equal to 10 lb since placed on experiment; total dry feed intake was greater than or equal to 7 lb; they appeared healthy; and they had been on the experiment for at least 3 wk. All calves were vaccinated for IBR-PI3, *Pasteurella*, BVD, BRSV, and *Clostridium* spp. (SmithKline Beecham Animal Health Div., West Chester, PA) between birth and 6 wk of age.

Table 1. Ingredients and Chemical Composition of Calf Starter

Ingredient	-- % as fed --
Corn, ground	41.1
Soybean meal	17.9
Oats, ground	15.0
Brome hay, ground	15.0
Molasses	7.0
Coccidiostat[1]	1.3
Binder[2]	1.0
Limestone	.9
Dicalcium phosphate	.4
Trace mineralized salt[3]	.2
Vitamin premix[4]	.2
Selenium premix (.06% Se)	.03
Chemical composition	
DM, %	90.0
	-- % of DM --
Crude protein	15.0
Acid detergent fiber	8.2
Nondetergent fiber	16.7
Ash	7.7

[1]Provided 30 mg of Decoquinate (Deccox®; Rhône-Poulenc Ltd., Atlanta, GA) per lb of feed.

[2]Ameribond 2x®, Lignotech, Greenwich, CT).

[3]Contained 99% NaCl, .007% I, .24% Fe, .05% Mg, .032% Cu, .011% Co, and .03% Zn.

[4]Provided 1000 IU of vitamin A, 140 IU of vitamin D, and 32 IU of vitamin E per lb of feed.

Beginning weight, and weights at 2, 4, and 6 wk and on 2 consecutive days at 8 wk were recorded. Fecal scores (1 = firm to 4 = liquid) were recorded daily. Amount of starter consumed was determined daily and totaled weekly.

Results and Discussion

Weekly and total dry feed intakes and biweekly and total body weight gains are reported in Table 2. Ages at weaning were 28.5 and 29.7 days for calves assigned to treatment and control, respectively. Age at weaning, weekly or total dry feed intake, and biweekly or total body weight gain were not affected by antioxidant supplementation or gender. Others have reported that supplemental antioxidants had no effect on body weight gain, whereas one research group reported that calves that received supplemental vitamin E had more rapid weight gains.

Scour scores of heifer calves with lighter birth weights did not differ from those of control calves during the first week, but bull calves with lighter birth weights had more ($P<.01$) severe scours than control calves. Heifer calves with intermediate birth weights had more ($P<.01$) severe scours than control calves during the first week; bull calves with similar birth weights did not have as severe scours as the heifers, but scours were more ($P<.05$) severe for treated than control calves. Heifer calves with heavier birth weights had more ($P<.001$) severe scours than control calves during the first week, but bull calves with similar birth weight did not have scour scores different from control calves. During the second week of the experiment, antioxidant supplementation decreased ($P<.001$) the severity of scours for heifer calves with light and

intermediate birth weights, but increased ($P<.001$) the severity of scours for bull calves of similar birth weights. Scour scores for bull and heifer calves with heavier birth weights and receiving the antioxidant combination were not different from scores of control calves of similar birth weights.

The decreased beneficial response of antioxidant supplementation in heifer calves of heavier birth weights during the second week could be related to the amount of antioxidant combination received. Because all heifer calves received the same quantity of the antioxidant combination, as body weight increased, the amount of the antioxidant combination received expressed as a percentage of body weight decreased.

The lack of benefit observed in these calves might have been due to adequate antioxidants available in their feedstuffs or because the amount of stress was low. In this experiment, calves were moved less than 200 yards to individual hutches and had ample bedding to keep them dry following birth.

Table 2. Averages of Total and Weekly Dry Feed Intake and Total and Biweekly Gains

	Dry feed intake, lb			Weight gain, lb		
Age, wk	Treatment[1]	Control[2]	SEM	Treatment[1]	Control[2]	SEM
1	3.1	2.6	5.5	—	—	—
2	4.0	3.1	5.5	2.4	2.6	1.6
3	7.7	7.3	5.5	—	—	—
4	16.7	14.1	5.5	17.6	14.3	1.6
5	32.8	27.9	5.5	—	—	—
6	40.7	38.5	5.5	24.6	24.9	1.6
7	63.6	49.7	5.5	—	—	—
8	54.3	54.3	5.5	27.9	28.6	1.6
Total	206.8	194.9	9.2	72.5	70.4	2.9

[1]Received daily 100 IU of d-alpha tocopherol, 500 mg of ascorbic acid, 5 mg of beta carotene in 5 ml of carrier until weaning.

[2]Received daily 5 ml of carrier alone until weaned.