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Vitamin E requirements of dairy calves

Abstract
Thirty-two Holstein heifer calves receiving conventional rations were supplemented with 0 (control), 125, 250, or 500 IU vitamin E/calf/day. The objective was to determine the optimum requirement based on their performance from birth to 24 wk of age. Results on weight gains, feed consumption, serum enzymes indicative of cell membrane damage, immune responses, and metabolic profile indicated that supplementation of calves receiving conventional rations with 125 to 250 IU/day may maximize their performance.; Dairy Day, 1986, Kansas State University, Manhattan, KS, 1986;

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VITAMIN E REQUIREMENTS OF DAIRY CALVES[1]

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Summary

Thirty-two Holstein heifer calves receiving conventional rations were supplemented with 0 (control), 125, 250, or 500 IU vitamin E/calf/day. The objective was to determine the optimum requirement based on their performance from birth to 24 wk of age. Results on weight gains, feed consumption, serum enzymes indicative of cell membrane damage, immune responses, and metabolic profile indicated that supplementation of calves receiving conventional rations with 125 to 250 IU/day may maximize their performance.

Introduction

The vitamin E requirement of dairy calves has not been determined nor has the effect of supplementation on the immune response been studied adequately. Earlier studies indicated that calves fed conventional rations do not receive adequate amounts of vitamin E and supplementation could enhance their general performance and immuno-competency. The objective of this research was to study the performance of calves from birth to 24 wk of age when supplemented daily with graded amounts of vitamin E.

Procedures

Thirty-two Holstein heifer calves were used from birth to 24 wk of age. Calves were allotted at birth to four treatments: 0 (control), 125, 250, or 500 IU supplemental vitamin E. All calves received colostrum for the first 3 days and then milk at 8% of birth weight until weaning at 6 wk. They were housed in hutches until 8 wk of age and had free access to water and a conventional calf starter. Then they were moved to group pens, where they had access to alfalfa hay and were individually fed a concentrate ration. The ingredient and chemical composition of calf starter and concentrate are shown in Table 1.

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[1]Partial financial support from Hoffman-La Roche, Nutley, NJ

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Table 1. Ingredient and chemical composition of dry feeds

Ingredients %	Calf Starter	Concentrate
Corn, rolled	30.00	41.00
Oats, rolled	20.00	25.00
Sorghum grain, rolled	7.50	
Wheat bran		10.00
Alfalfa hay, ground	25.00	
Soybean meal	10.00	17.00
Molasses, dry	5.00	4.00
Animal fat		2.00
Dicalcium phosphate	0.70	
Limestone, ground	0.30	0.28
Salt, plain	0.25	0.25
Salt, trace mineral	0.25	0.25
Vitamin and selenium premix[1]	1.00	
Vitamin premix[2]		0.22
<u>Chemical Composition</u>		
Crude protein, %	15.61	16.15
Ether extract, %	3.36	3.64
Acid detergent fiber, %	19.95	13.14
Vitamin E, IU/kg	21.60	75.20

[1]Included 220,264 IU Vitamin A, 33,039 IU Vitamin D, 0.2159 g sodium selenite/kg premix.

[2]2.2 million IU Vitamin A and 2.2 million IU of Vitamin D/kg.

Weight gains were recorded weekly until 8 wk of age and then monthly. Consumption of calf starter and concentrate mixture were recorded daily. Jugular blood was sampled at frequent intervals for determination of various serum enzymes, immune responses, metabolic profile, and hematological traits.

Results and Discussion

Data on the performance, serum enzymes, immune responses, and metabolic profile are presented in Table 2.

Overall weight gains were significantly higher in calves supplemented with 125 or 250 IU than in control calves; gains of calves given 500 IU were intermediate. Total consumption of concentrate was similar in all groups, but calves given 500 IU showed a trend toward lower consumption. Higher weight gains but similar feed consumption in calves given 125 or 250 IU, compared with control calves, resulted in increased feed efficiency.

Table 2. Effect of supplemental vitamin E on the performance, serum enzymes, metabolic profile, and immune response of calves

Item	IU of Supplemental Vitamin E/calf/day 0	124	250	500	S.E. of Mean
Overall weight gains, kg	125[a]	144[b]	143[b]	131[ab]	5.4
Concentrate consumption, kg	370	387	367	324	26.3
Fecal scores[1]	1.4	1.4	1.3	1.4	0.04
Creatine kinase, IU/l[1]	184.1	169.6	170.0	174.8	8.9
Glutamic oxalacetic transaminase, IU/l[1]	66.8[a]	56.1[b]	62.2[a]	61.3[ab]	2.0
Lactic dehydrogenase, IU/l[1]	971[a]	845[b]	894[ab]	884[ab]	31.7
Serum α-tocopherol, IU/dl[1]	88.5[a]	166.5[b]	269.0[c]	289.0[c]	8.6
Lymphocyte stimulation indices[1]					
Phytohemagglutinin	31.6[a]	39.5[ab]	39.9[b]	35.2[ab]	2.9
Concanavalin A	29.2[a]	37.2[b]	34.5[ab]	36.3[b]	2.2
Pokeweed Mitogen	20.3[a]	24.5[ab]	23.2[ab]	26.9[b]	1.5
Lipopolysaccharide	3.7[a]	5.8[b]	5.0[ab]	5.9[b]	0.6
Serum cortisol, ng/ml[1]	5.2[a]	3.3[b]	2.9[b]	3.9[b]	0.4
Serum anti BHV-1 antibody ($x10^4$)[2]	1.5[a]	7.5[b]	3.0[ab]	6.8[ab]	
Serum glucose, mg/dl[1]	92.8[a]	105.3[b]	108.6[b]	105.8[b]	3.2

[abc]Means within rows with different superscripts differ (P<.05).

[1]Least square means averaged across weeks.

[2]ELISA (IgG) titers determined at 24 wk of age in response to a commercial modified live intra nasal bovine herpes virus type 1 vaccine at 7 and 21 wk of age.

Unsupplemented calves had lower blood vitamin E and elevated serum enzymes, indicating that cell membranes were prone to damage. Lymphocyte blastogenic responses to various T and B-cell mitogens were lower in unsupplemented calves, compared with some supplemented groups. Serum anti-bovine herpes virus type-1 antibody (IgG) response to booster vaccination was higher in calves given 125 IU than in control calves. Overall concentrations of cortisol in serum were higher in unsupplemented calves than in supplemented calves, partially explaining the reasons for higher immune response in supplemented calves.

It is concluded that supplementation of conventional rations with 125 or 250 IU vitamin E per animal per day can increase the performance of calves.