THE EFFECTS OF VITAMIN E SUPPLEMENTATION ON FEEDLOT STEER PERFORMANCE, CARCASS CHARACTERISTICS AND MEAT TENDERNESS

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Story In Brief

Vitamin E was supplemented to 192 continental crossbred yearling steers to determine animal performance, carcass characteristics and meat tenderness. Steers were blocked by weight (12 head/pen) into 16 pens and received a high moisture corn-based ration containing one of four vitamin E levels: 39 (L), 80 (ML), 212 (MH) or 454 (H) IU per day. Blood samples were collected from three steers/pen at each weighing (every 28 d) to evaluate vitamin E concentration. Rib sections from 94 randomly selected carcasses (6/pen) were removed and steaks were cut and aged for 14, 21 or 28 days to determine effects of vitamin E supplementation on meat tenderness. No differences in performance or carcass characteristics were noted for increased levels of vitamin E. Vitamin E blood concentration corresponded to level of supplementation throughout the feeding period and significantly differed among groups at days 39, 65, 97 and 125 of the trial. No differences in Warner Bratzler shear force (tenderness) or cook loss were found among vitamin E treatment groups at any aging period; however, as steaks were aged, shear force tended to decrease resulting in increased percentages of very tender (< 8.6 lb) and tender (8.6 to 10.0 lb) steaks as well as decreased percentages of tough (> 10.0 lb) steaks for all supplemental levels of vitamin E. Among quality grades, steaks from U.S. Choice carcasses tended to be the most tender while U.S. Standard steaks tended to be the toughest. The results of this trial suggest feedlot performance, carcass characteristics and meat tenderness of steers are not affected by vitamin E supplementation.

(Key Words: Beef, Tenderness, Vitamin E.)

Introduction

The National Cattlemen's Beef Association has advocated the inclusion of Vitamin E in feedlot diets, primarily to prolong the shelf-life of retail cuts. Currently, no premium is paid to producers for vitamin E fed beef. Consequently, a boost in animal performance is necessary for cattle feeders to

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recover the cost of supplementing vitamin E. Previous research conducted at Oklahoma State University (Secrist et al., 1995) revealed animal performance and product shelf-life were enhanced by supplementing with vitamin E; however, meat tenderness tended to decrease with increased levels of vitamin E. Accordingly, this study was conducted to 1) determine the optimum dietary vitamin E level required to enhance animal performance and 2) determine the effects of supplemental vitamin E on meat tenderness.

Materials and Methods

Animals. Continental crossbred yearling steers (n=192) were received at the Oklahoma Panhandle State University feedlot research facilities at Goodwell, OK on January 6, 1995 (d-13). Upon arrival, the steers were weighed, individually tagged, vaccinated with a 4-way respiratory and 7-way clostridial vaccine, injected with Ivomec-F® and implanted with Synovex-S®. Revalor-S® was re-implanted on d 39. The steers were stratified by weight into four weight blocks and assigned randomly to one of four diets containing 39, 80, 212 or 454 IU vitamin E/steer daily. The concentration of vitamin E in the diets reflects actual amounts; steers receiving 39 IU daily did not receive supplemental vitamin E as this diet was used as the control. Steers were fed (12 head/pen) in 16 outside pens with cement fenceline feedbunks. Vitamin E treatments began on January 21, 1995 (d 0) after a thirteen day adaptation period.

Diets. Isocaloric and isonitrogenous high moisture corn based diets were available ad libitum. The basal ingredients (corn and alfalfa hay) were analyzed in a commercial laboratory for dry matter, crude protein, calcium, phosphorous and potassium. Additionally, all feed was analyzed for vitamin E content. Vitamin E supplements were mixed using Hoffman LaRoche Inc. Spray-Dried-50 (226, 800 IU/lb) and rolled corn to form a pellet containing 39, 80, 212 or 454 IU vitamin E/steer daily. The supplement was weighed (1 lb/pen) and top-dressed daily.

Data Collection. The steers were weighed on days 0, 14, 39, 69, 97 and 124. Feed and supplement samples were taken monthly and vitamin E content was determined by a Hoffman LaRoche laboratory in Nutley, NJ. Blood samples were taken from three calves/pen at each weighing to determine vitamin E concentration.

Steers were slaughtered on day 129 or 130 at a commercial meat packing facility. After a 48 hour postmortem chill, data were collected for yield and quality grade determinations (USDA, 1989). Rib sections from 94 randomly selected carcasses (approximately 6/pen) were removed and shipped to the Oklahoma State University Meats Laboratory where steaks (1.0 inch thick)

were cut, vacuum packaged, aged for 14, 21 or 28 days at 34°F and subsequently frozen (-22°F). Steaks later were thawed at 36°F for a period of 24 hours and broiled to a medium degree of doneness (158°F) using an impingement oven. Upon cooling to room temperature, an average of six 0.5 inch diameter cores were removed from each ribeye steak for shear force (tenderness) measurement using a Warner-Bratzler attachment to an Instron Universal Testing Machine.

Performance, vitamin E blood concentrations and carcass grade data were analyzed using contrasts to examine linear, quadratic or cubic. effects. P values are reported for these effects. The PROC GLM procedure of SAS was used to analyze shear force and cooking loss values with steer nested within block x vitamin E concentration as the appropriate error term.

Results and Discussion

Cattle Performance. Performance data are summarized in Table 1. No significant differences were observed among treatment groups for average daily gain, although feed efficiency decreased and dry matter intake tended to increase linearly (P=.09) with supplemental vitamin E. Once vitamin E was supplemented, the level of vitamin E in the blood (Table 2) increased linearly for steers receiving 212 and 454 IU of vitamin E throughout feeding.

Carcass Characteristics and Meat Tenderness. Carcass yield and quality grade characteristics stratified by treatment group are reported in Table 3. No significant differences were observed among treatment groups for yield or quality grade determinants.

Warner-Bratzler shear force and cook loss values of ribeye steaks aged 14, 21 or 28 days from steers receiving supplemental vitamin E are reported in Table 4. No differences in shear force or cook loss were found among beef steers supplemented with vitamin E. As expected, steaks aged for 21 or 28 days were significantly more tender than steaks aged for 14 days; however, no difference in shear force was detected between 21 and 28 day aged steaks (not reported in tabular form). Percentage of very tender and tender ribeye steaks increased, while percentage of tough steaks decreased with increased aging time for all levels of supplemental vitamin E (Table 4). As reported in previous studies, carcasses with higher degrees of marbling (of a higher quality grade) produced steaks having more desirable shear force values (Table 5). U.S. Choice and U.S. Select steaks aged for 14 and 28 days were more tender than steaks from U.S. Standard carcasses. Interestingly, no difference in tenderness was detected among quality grades for steaks aged 21 days; although steaks from U.S. Choice carcasses tended (P=.05) to require less shear force than U.S. Standard steaks.

Implications

Results from this study suggest supplementing steers with vitamin E during the finishing phase neither enhances performance nor improves carcass grade traits. Supplemental vitamin E may be fed to extend beef shelf-life without having detrimental effects on meat tenderness.

Literature Cited

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Table 1. Feedlot performance for steers fed supplemental vitamin E.

Item	39 IU	80 IU	212 IU	454 IU	P <
Live weight, lb					
Start	734	736	740	738	L, .98
Day 129	1263	1243	1249	1245	L, .56
Intake, lb	20.0	19.4	20.1	20.4	L, .09
ADG, lb	4.07	3.93	3.96	4.01	L, .93
Feed:Gain	4.92	4.95	5.09	5.09	L, .09

Table 2. Vitamin E blood levels for steers fed supplemental vitamin E.

Item	39 IU	80 IU	212 IU	454 IU	P <
Vit. E blood level, ug/ml					
Day 0	1.31	1.27	1.41	1.25	.80
Day 39	1.60	1.90	2.64	3.19	.001
Day 65	1.90	1.66	2.37	4.39	.001
Day 97	2.65	1.50	3.50	4.37	.001
Day 125	2.80	2.85	3.46	7.50	.001
Change, Day 0 to 125	1.30	.89	1.64	4.44	.001

Table 3. Carcass yield and quality grade factors of steers fed supplemental vitamin E.

Item	39 IU	80 IU	212 IU	454 IU	P <
Dressing %	65.3	65.2	65.7	65.1	L, .54
Fat thickness, in	.43	.38	.41	.39	L, .23
KPH, %	1.4	1.4	1.4	1.4	L, .50
REA, in^2	14.8	14.7	14.8	15.1	L, .22
Carcass weight, lb	802	789	793	791	L, .56
Yield grade	2.2	1.9	2.0	1.9	L, .12
Marbling Score[a]	Sl^{36}	Sl^{58}	Sl^{37}	Sl^{44}	L, .86
Choice, %	19.6	29.2	14.6	21.3	L, .69
Select, %	52.2	56.3	64.6	55.3	L, .80
Standard, %	28.3	14.6	18.8	23.4	L, .94

[a] Marbling score: "Sl" = slight degree, the minimum required for U.S. Select (USDA, 1989).

Table 4. Shear force, cooking loss, and percentages of very tender, tender and tough ribeye steaks[a] for steers fed supplemental vitamin E.

Item	39 IU	80 IU	212 IU	454 IU	P <
Number of steaks	22	25	24	23	
Shear force, lb					
14-Day aging	7.95	8.01	8.23	8.13	.96
21-Day aging	7.58	7.43	7.58	7.48	.65
28-Day aging	7.40	7.68	7.55	7.53	.56
Cook loss, %					
14-Day aging	25.3	25.2	26.3	25.4	
21-Day aging	24.6	24.5	24.2	24.7	
28-Day aging	25.3	25.8	25.5	25.0	
14-Day aging					
% Very Tender	63.6	72.0	62.5	69.6	
% Tender	22.72	12.0	20.8	21.7	
% Tough	13.6	16.0	16.7	8.7	
21-Day aging					
% Very Tender	72.7	76.0	87.5	82.6	
% Tender	27.3	24.0	8.3	17.4	
% Tough	0.0	0.0	4.2	0.0	
28-Day aging					
% Very Tender	90.9	84.0	87.5	87.0	
% Tender	9.1	8.0	12.5	8.7	
% Tough	0.0	8.0	0.0	4.3	

[a] Based on shear force: very tender = 8.5 lb or less; tender = 8.6 to 10.0 lb; tough = greater than 10.0 lb.

Table 5. Shear force values (lb) stratified by aging time and quality grade.

	Quality level		
Aging time	Choice	Select	Standard
Number of steaks	19	51	24
14-Day	7.47[b]	8.00[b]	9.14[a]
21-Day	7.21[d]	7.60[cd]	7.98[c]
28-Day	7.27[b]	7.48[a]	8.27[a]

[a,b] Means in the same row with a common superscript letter do not differ (P>.05).

[c,d] Means in the same row with a common superscript letter do not differ (P>.10).