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South Dakota Beef Report, 2006 | Animal Science Reports

2006

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Recommended Citation

Parr, Sandi L.; Pritchard, Robbi H.; and Bruns, Kelly W., "Effect of Single vs. Pulsing Doses of Estradiol 17-β and Trenbolone Acetate in Finishing Steers Fed a High Concentrate Diet" (2006). *South Dakota Beef Report, 2006.* Paper 4.
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Effect of Single vs. Pulsing Doses of Estradiol 17-β and Trenbolone Acetate in Finishing Steers Fed a High Concentrate Diet[1]

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BEEF 2006 - 03

Summary

The effect of implant dosing pattern on anabolic response was evaluated in predominately Angus steers (n=192). Steers, except the control, were implanted with 1 of 3 different implant strategies. Cumulatively all implant treatments received a dose of 24 mg estradiol 17-β (E_2) and 120 mg trenbolone acetate (TBA). Dosing patterns were 8 mg E_2 and 40 mg TBA given 3 times; 12 mg E_2 and 60 mg TBA given 2 times or 24 mg E_2 and 120 mg TBA given 1 time. Implanted cattle had heavier body weights, increased average daily gain, and lower feed conversion compared to non-implanted controls. There were no differences among the implant treatments for cumulative 133 d body weight gain or average daily gain. Carcass quality was not affected by implant or implant dosing pattern. Dosing pattern did have an affect on growth patterns.

Introduction

There has been a great deal of research conducted to determine the optimum anabolic dose needed to maximize anabolic response. However, research is limited in establishing the threshold dose needed to stimulate anabolic response and determine if implant dosing patterns affect anabolic response. For this experiment, multiple low doses of anabolic hormones were given in an effort to sustain anabolic concentrations. A comparison could then be made between those steers receiving multiple low doses of anabolic agents and those receiving a single high dose of anabolic agent. The objective of this study was to determine the effect of implant dosing pattern on finishing steer performance and carcass characteristics.

Materials and Methods

Predominately Angus steers (n=192) which were previously in a backgrounding experiment, were assigned to this experiment. Steers had been vaccinated and treated for parasites prior to initiation of the backgrounding experiment. The steers were not implanted during the backgrounding experiment.

All implant treatments were designed to provide a cumulative dose of 24 mg of estradiol 17-β (E_2) and 120 mg of trenbolone acetate (TBA). The 4 treatments evaluated were 1) no implant control; 2) 8 mg E_2 and 40 mg TBA administered on days 0, 42 and 84; 3) 12 mg E_2 and 60 mg TBA administered on days 0 and d 63; and 4) 24 mg E_2 and 120 mg TBA administered on day 0 (Table 1).

Table 1: List of Implant Treatments

	Treatments			
	1	2	3	4
	E_2:TBA, mg			
Day				
0	--	8:40	12:60	24:120
42	--	8:40	--	--
63	--	--	12:60	--
84	--	8:40	--	--

[1] This project funded by the Beef Nutrition Program and the SD Ag Experiment Station.
[2] Graduate Student
[3] Distinguished Professor
[4] Associate Professor

Steers were stratified by body weight, separated into two weight categories (light 774 ± 63 lb and heavy 867± 49 lb) and randomly assigned within each weight category to an implant treatment during a 20 d pre-test phase. Cattle were acclimated to the final diet by day 0. The lighter group was started on experiment 14 d after the heavier group. A total of 24 pens were used (8 steers/pen and 3 pens/treatment within each weight category). Steers were stepped up from a 45% roughage diet to the final diet using a 4-step process. The roughage source for the final diet was initially corn silage; this was replaced by oat hay at d 98 for the heavy group and d 84 for the light group. All treatments were fed similarly (Table 2) except that for the last 21 days on feed, oatlage replaced oat hay for the lighter group only. Feed ingredients were assayed weekly and DMI and diet composition (except NE_m and NE_g) were calculated from the laboratory values.

Table 2: Formulations and Compositions of Finishing Diets[a]

	Diets[b]	
	1	2
Corn silage	5.92	--
Oat hay[c]	--	3.00
Whole shell corn	55.15	55.90
High moisture ear corn	26.83	28.70
Soybean meal	7.80	8.30
Liquid supplement[d]	4.30	4.10
	100.0	100.0
DM[e]	71.0	81.0
CP[e]	12.5	13.1
NDF[e]	13.2	13.5
NE_m, Mcal/cwt[f]	92.0	92.4
NE_g, Mcal/cwt[f]	61.4	61.5

[a]DM basis.
[b]Diet 1 was fed until d 98 (heavy group)and d 84 (light group) when diet 2 was fed.
[c]Replaced with oat silage for the lighter group at 112 d on feed.
[d]Provided monensin at 29 g/T and urea at 0.76% of final diet; supplied minerals and vitamins to meet or exceed nutrient requirements (NRC, 2000).
[e]Calculated from lab assays
[f]Calculated from tabular values

Body weights were recorded prior to feeding every 21 d except the final weight which was at a 28 d interval. The final body weight was recorded in the morning and cattle were shipping that evening to Tyson Fresh Meats, Dakota City, NE. Slaughter occurred the following morning and individual cattle identity was tracked through the slaughter process. Carcass data were collected approximately 30 h after slaughter. Hot carcass weight was recorded and ribeye area and subcutaneous rib fat were measured. Marbling scores and KPH fat, (%) were assigned by an USDA grader, Yield Grade was calculated from the carcass values collected. Three calves were realized and removed from the data for reasons not related to treatments. Carcass data were not captured on 9 steers.

Data were analyzed as a completely random design with a 2 x 4 factorial arrangement of treatments with factors of weight group and implant treatment. Steer performance was analyzed using pen as the experimental unit. Carcass data were analyzed using the individual as the experimental unit. All performance and carcass variables were analyzed using the General Linear Model (GLM) procedure of SAS. If the GLM evaluation of treatment was significant ($P < 0.05$) then treatment means were separated using Fishers T test.

Results and Discussion

The interim performance is summarized by weigh dates (Table 3) and cumulative intervals (Table 4) corresponding to implant dates. Only main effects of treatment are reported as no weight group x treatment interaction occurred. The cumulative intervals depict how growth curves responded to implant dosages. During the first 42 d, implants did not affect (*P* = 0.1082) ADG or DMI but F/G was lower (*P* < 0.05) for implanted cattle.

Table 3: Interim Performance by Treatment[a]

	Treatment				
	1	2	3	4	SEM
Implant dose (E_2:TBA), mg	--	8:40	12:60	24:120	
Frequency	--	3	2	1	
Initial BW	817	818	821	825	2.96
1 to 21 d					
BW, lb	887	896	898	905	4.52
ADG, lb	3.37	3.70	3.64	3.79	0.19
DMI, lb	19.50	19.66	19.31	19.83	0.44
F/G	5.95	5.56	5.41	5.33	0.23
22 to 42 d					
BW, lb	984^{b}	997^{bc}	1000^{bc}	1018^{c}	7.24
ADG, lb	4.59	4.84	4.86	5.37	0.21
DMI, lb	22.05	22.18	21.68	22.71	0.59
F/G	4.87^{b}	4.61^{bc}	4.49^{c}	4.26^{c}	0.12
43 to 63 d					
BW, lb	1056^{b}	1074^{bc}	1073^{bc}	1093^{c}	7.67
ADG, lb	3.43	3.63	3.46	3.61	0.19
DMI, lb	22.96	23.61	22.76	24.09	0.47
F/G	6.77	6.64	6.71	6.79	0.32
64 to 84 d					
BW, lb	1119^{b}	1146^{c}	1149^{c}	1164^{c}	6.97
ADG, lb	3.01^{b}	3.44^{c}	3.64^{c}	3.35^{bc}	0.15
DMI, lb	23.24	24.01	23.21	24.47	0.44
F/G	7.78	7.04	6.42	7.56	0.43
85 to 105 d					
BW, lb	1195^{b}	1233^{c}	1235^{c}	1239^{c}	7.98
ADG, lb	3.64	4.17	4.07	3.60	0.21
DMI, lb	23.76^{b}	25.13^{cd}	24.20^{bc}	25.54^{d}	0.38
F/G	6.74	6.03	6.03	7.32	0.39
106 to 133 d					
BW, lb	1267^{b}	1326^{c}	1319^{c}	1329^{c}	7.84
ADG, lb	2.56^{b}	3.32^{c}	3.01^{bc}	3.20^{c}	0.16
DMI, lb	23.29^{b}	25.46^{cd}	24.48^{bc}	25.89^{d}	0.40
F/G	9.15	7.73	8.29	8.31	0.44

[a]Calculated using unshrunk live body weight.
[b,c,d]Means in the same row without a common superscript differ (*P* < 0.05).

Table 4: Cumulative Intervals of Steer Performance Corresponding to Implanting[a]

	Treatments				
	1	2	3	4	SEM
Implant dose (E_2:TBA), mg	--	8:40	12:60	24:120	
Frequency	--	3	2	1	
1 to 42 d					
ADG, lb	3.98	4.27	4.25	4.58	0.16
DMI, lb	20.77	20.92	20.49	21.27	0.47
F/G	5.22^{b}	4.91^{c}	4.83^{c}	4.68^{c}	0.10
43 to 83 d					
ADG, lb	3.22	3.54	3.55	3.48	0.13
DMI, lb	23.10	23.81	22.98	24.28	0.44
F/G	7.23	6.81	6.49	7.13	0.29
1 to 63 d					
ADG, lb	3.80^{b}	4.06^{b}	3.99^{b}	4.25^{c}	0.11
DMI, lb	21.50	21.82	21.25	22.21	0.40
F/G	5.67^{b}	5.41^{c}	5.34^{c}	5.23^{c}	0.09
64 to 133 d					
ADG, lb	3.02^{b}	3.61^{c}	3.52^{c}	3.36^{c}	0.11
DMI, lb	23.42^{b}	24.93^{cd}	24.01^{bc}	25.36^{d}	0.35
F/G	7.80^{b}	6.92^{cd}	6.84^{d}	7.60^{bc}	0.25
1 to 84 d					
ADG, lb	3.60^{b}	3.90^{c}	3.90^{c}	4.03^{c}	0.07
DMI, lb	21.94	22.37	21.74	22.77	0.38
F/G	6.10^{b}	5.76^{c}	5.58^{c}	5.66^{c}	0.08
85 to 133 d					
ADG, lb	3.02^{b}	3.68^{c}	3.47^{c}	3.37^{bc}	0.13
DMI, lb	23.49^{b}	25.32^{cd}	24.36^{bc}	25.74^{d}	0.38
F/G	7.83^{b}	6.90^{d}	7.07^{cd}	7.68^{bc}	0.24
1 to 133 d					
ADG, lb	3.39^{b}	3.82^{c}	3.74^{c}	3.79^{c}	0.06
DMI, lb	22.51^{b}	23.45^{cd}	22.70^{bc}	23.87^{d}	0.33
F/G	6.65^{b}	6.15^{c}	6.07^{c}	6.31^{c}	0.08

[a]Calculated using unshrunk live body weight.
[b,c,d]Means in the same row without a common superscript differ ($P < 0.05$).

From d 1 to 63, implanted cattle had lower ($P < 0.05$) F/G compared to non-implanted cattle; with cattle in treatment 4 having greater ($P < 0.05$) ADG compared to other treatments. From d 64 to 133, implant treatments caused increased ($P < 0.05$) ADG, treatments 2 and 4 tended to have increased ($P < 0.10$) DMI compared to control and treatment 3. After the second anabolic dose was given to cattle in treatment 3 (d 64 to 133), F/G was decreased ($P < 0.05$) compared to cattle in treatment 4. Treatment 2 tended to decrease ($P < 0.10$) F/G compared to treatment 4. After the third anabolic dose was given to treatment 2 (d 85 to 133), F/G was decreased ($P < 0.05$) compared to treatment 4 and treatment 3 tended to have reduced ($P < 0.10$) F/G compared to treatment 4.

Implant treatments had increased ($P < 0.05$) cumulative carcass adjusted ADG compared with control steers (Table 5). Dosing pattern did not affect ($P > 0.05$) cumulative carcass adjusted ADG among implant treatments. Cumulatively, treatments 2 and 4 caused increased ($P < 0.05$) DMI compared to control. Cumulative DMI for treatment 3 was similar ($P > 0.05$) to the control and lower ($P < 0.05$) compared to treatment 4. Treatment 2 and 3 caused decreased ($P <. 0.05$) cumulative carcass adjusted F/G compared to control. Since cumulative ADG did not differ among implant treatments, the decrease ($P < 0.05$) in cumulative carcass adjusted F/G for treatment 3 compared to treatment 4 is probably accounted for by decreased DMI.

Although dosing pattern did not cause a difference in cumulative ADG it did affect the pattern of growth. For the first 63 d (Table 4) the change in ADG relative to control was 6.8, 5.0 and 11.8% for treatment 2, 3 and 4, respectively. From d 64 to 133, the response was 19.5, 16.6 and 11.3%, respectively. The response was 21.9, 14.9 and 11.6%, respectively, from d 85 to 133. Cattle receiving multiple low doses of E_2 and TBA seemed to have a slower decline in growth as days on feed increased verses those cattle receiving a single dose of E_2 and TBA (Figure 1).

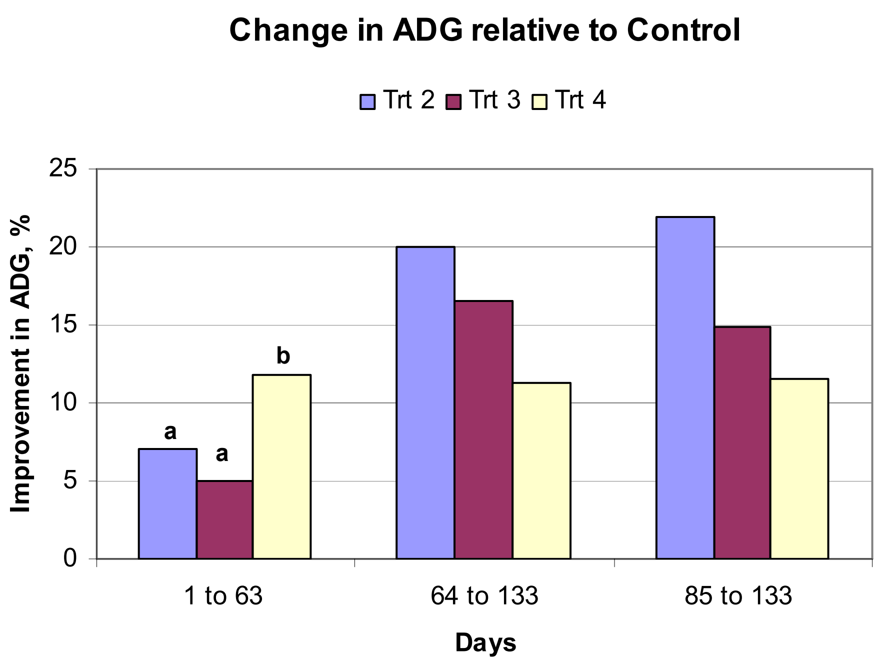

Figure 1. The effect of implants on improvement in ADG relative to cattle which were not implanted. Treatment 1 = control; Treatment 2 = 3 doses 8 mg E_2 and 40 mg TBA ; Treatment 3 = 2 doses 12 mg E_2 and 60 mg TBA; Treatment 4 = 24 mg E_2 and 120 mg TBA. [a, b] Means in the same group without a common superscript differ ($P < 0.05$).

Repeated administration of anabolic doses appears to sustain the anabolic response. The response in F/G (calculated using live, unshrunk body weight) to dosing pattern is more evident when F/G is viewed as % over controls (Figure 2). From d 1 to 63 the improvement in F/G relative to control was 4.6, 5.8 and 7.8% for treatment 2, 3, and 4, respectively. From d 64 to 133 the response was 11.3, 12.3 and 2.6%, respectively. From d 85 to 133, the % F/G improvement over controls was 11.9, 9.7 and 1.9% respectively.

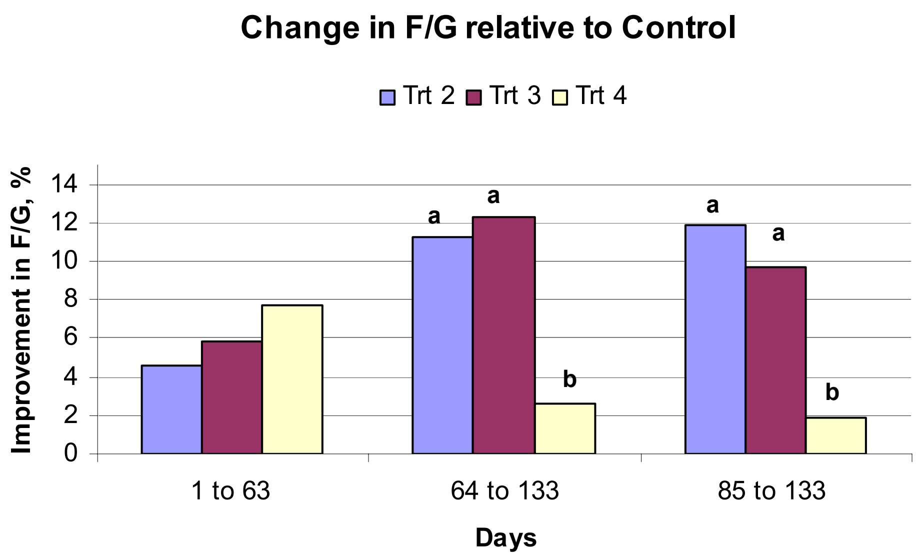

Figure 2. The effect of implants on improvement in F/G relative to cattle which were not implanted. Treatment 1 = control; Treatment 2 = 3 doses 8 mg E_2 and 40 mg TBA ; Treatment 3 = 2 doses 12 mg E_2 and 60 mg TBA; Treatment 4 = 24 mg E_2 and 120 mg TBA. [a, b] Means in the same group without a common superscript differ (P < 0.10).

Implanting increased (P < 0.05) carcass weight an average of 33 lb (Table 5). Treatments 3 and 4 had an increased (P < 0.05) ribeye area compared to control. Yield Grade and marbling score were not affected by treatment (P > 0.15) while KPH fat tended (P < 0.10) to be lower for treatment 2. Two important points should be made when the effects of implants on Quality Grades are considered for this study. The first being that these cattle had exceptionally high overall Quality Grades and the marbling response to implants seen in this experiment may not be typical of all cattle. Secondly, this experiment was designed to target anabolic activity when caloric intake was not limited. When adaptation to diet does not occur prior to implanting, outcomes may be different.

Table 5: Cumulative Steer Performance and Carcass Characteristics by Treatment[a]

	Treatment				
	1	2	3	4	SEM
133 d Cumulative					
Adjusted end wt[b]	1233[d]	1283[e]	1289[e]	1285[e]	8.69
ADG, lb	3.13[d]	3.49[e]	3.52[e]	3.45[e]	0.06
DMI, lb	22.51[b]	23.45[cd]	22.70[bc]	23.87[d]	0.33
F/G	7.19[d]	6.73[ef]	6.46[f]	6.93[de]	0.12
Hot carcass wt, lb	771[d]	802[e]	806[e]	803[e]	7.53
Dress, %	60.84[de]	60.42[d]	61.09[e]	60.41[d]	0.002
Ribeye area, in^2	12.70[d]	13.00[de]	13.36[e]	13.30[e]	0.19
Ribfat depth, in	0.49	0.47	0.52	0.55	0.02
KPH, %	1.95	1.70	1.84	1.76	0.007
Marbling score[c]	6.41	6.17	6.31	6.16	0.16
Yield Grade	2.99	2.91	2.96	3.03	0.07
Choice or better, %	91.1	90.7	87.2	82.2	

[a]Least squares means.
[b]Calculated as hot carcass wt ÷ 0.625.
[c]Small^0 = 5; Modest^0 = 6.
[d,e,f]Means in the same row without a common superscript differ ($P < 0.05$).