Effect of Implanting on Performance and Carcass Characteristics of Finishing Steers

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Story in Brief

To evaluate the effect of implant strategy on finishing performance, carcass characteristics, and longissimus muscle tenderness, short yearling (n=150, 636 ± 4.2 lb) mixed crossbred steers were assigned to one of five implant regimes during a 180-d finishing trial. Treatments were: 1) no implant (NC); 2) implant d 1 (R_1); 3) two implants d 1 ($2R_1$); 4) implant d 1, reimplant d 94 (R_1R_{94}); or 5) implant d 1, explant and reimplant d 94 (R_1ER_{94}). Overall daily gain was 13.5% greater for implanted steers compared with NC steers, and was 7.2% greater in steers with two implants vs one implant. Overall DMI tended to be greater in implanted compared with NC steers, whereas DMI did not differ among implanted steers. Similar to daily gain, implanted steers had improved feed:gain vs NC (5.86 vs 6.33), and steers receiving two implants had improved feed:gain compared with R_1 steers (5.77 vs 6.13). Implanted steers yielded 46 lb more hot carcass weight than NC steers. Implant treatment had no effect on lean and skeletal maturity, ribeye area, marbling score or USDA Quality grade. USDA Yield grade was lower in $2R^1$ steers compared with R^1R^{94} steers (2.40 vs 2.87). Implanting twice resulted in greater performance and carcass weight compared with implanting once. Warner-Bratzler shear force was greater for implanted steers compared with NC (9.47 vs 12.25 lb). These results suggest that implanting steers during the finishing period enhances rate and efficiency of gain with minimal effects on all carcass traits. However, implanting steers did reduce tenderness of 7-d aged steaks.

Key Words: Implant, Performance, Carcass Traits

Introduction

It is not difficult to justify the use of implants in the U. S. beef industry today if our goal is to meet demand. This justification can be made by examining the added pounds of carcass weight realized with the use of one combination (estradiol + Trenbelone Acetate) implant. For example, Gardner et al. (1999) and Berry et al. (2000) observed an increase of 54 to 87 lb of additional carcass weight in previously non-implanted steers compared with NC. With this in mind, subtracting 50 lb of carcass weight from each steer and heifer harvested in the United States in the year 2000 (30 million, USDA) would have decreased beef production by approximately 1.5 billion lb. Thus, with the demand for beef at its current levels, the use of implants is necessary. However, the use of implants, or more likely TBA and estradiol implants, have been shown to have negative effects on the end product which in turn may cause a decrease in the demand for beef. The negative effects may include decreased marbling scores, advanced lean and skeletal maturity, as well as decreased tenderness. A number of investigators have concluded from both objective and subjective measures that the use of implants is detrimental to carcass quality and tenderness. For example, Gerken et al. (1995) observed by objective measure that a single estrogenic implant decreased ($P<.05$) tenderness of top sirloin steaks while a single androgenic and a single combination implant had no effect. In contrast, Samber et al. (1996) observed that steers implanted with combination implants two or three times throughout the finishing period had decreased tenderness ($P<.05$) compared with controls, while steers receiving an estrogenic and a combination implant had no effect. Foutz et al. (1997) reported that steers given an initial combination implant had decreased percentage of U. S. Choice and tended to have higher shear force values compared with controls. More importantly, Roeber et al. (2000), when evaluating the effects of different implant strategies on consumer acceptability, found that certain implant strategies reduced consumer preference of tenderness of steaks. These results are cause for alarm and should compel us to evaluate our implanting goals more closely so that attempts to improve performance do not reduce the demand for beef.

Materials and Methods

Animals and Diets. One hundred fifty mixed crossbred steers (BW = 636 ± 4.2 lb) were received at the Willard Sparks Beef Cattle Research Center, Stillwater, OK, in the spring of 2000. Upon arrival steers were individually weighed on three consecutive days (d -1, 0, 1); on d -1, steers were individually ear-tagged for identification. On d 1 steers were processed, blocked by the average weight of d -1 and d 0, and allotted to one of 30 pens (10 pens/block; 5 hd/pen) for a 180-d finishing study. At processing all treatment groups where vaccinated with BRSV VAC 4®, and treated for internal and external parasites using Ivomec® injectable. Appropriate treatments were also administered at processing and treatments on d 1 were: 1) no implant (NC); 2) implant d 1 (R_1); 3) two implants d 1 ($2R_1$); 4) implant d 1, reimplant d 94 (R_1R_{94}); and 5) implant d 1, explant and reimplant d 94 ($R_{1,}ER_{94}$). On d 94, steers from Treatments 4 and 5 were taken to the processing barn where R_1R_{94} steers received a single combination implant, and R_1ER_{94} steers had their initial implant removed and replaced with a new combination implant.

Steers were housed in 30 partially covered pens. Pen shades primarily functioned as shade for the steers and to protect the feed bunk from the elements, which allows for a more accurate measure of feed intake. Steers were adapted to a 92% concentrate diet that consisted of 82.5% rolled corn, 8% cottonseed hulls, 3% yellow grease, and 9.5% supplement. The final diet contained 13.1% crude protein and had an energy content of 98.5 Mcal/cwt of NE_m and 63.1 Mcal/cwt NE_g on a DM basis. Slick bunk management was used and bunks were read at 0700, approximately 1 h before feeding, to determine the amount of feed to be offered that day. Steers were weighed three consecutive days at arrival and once every 28 d thereafter. All intermittent weights were subjected to a 4% shrink, and final live weights were calculated by dividing each animal's hot carcass weight by an average dressing percentage for steers harvested on the same day. Dressing percentages were 64.2% for Blocks 1 and 2, and 61.7% for Block 3.

Steers from weight Blocks 1 and 2 (heavy and medium) were harvested after 165 d on feed and Block 3 (light) was harvested after 180 d on feed. All steers were harvested at Excel Corporation Dodge City, KS. At harvest steer identification was transferred to their corresponding carcass, carcass weights and percentage of internal fat were recorded and Elanco Animal Health personnel scored livers for degree of abscesses. Following a 32^{o}F approximately 36-h chill period, Oklahoma State University personnel collected ribeye area, marbling score, lean and skeletal maturity, 12th rib fat, and recorded USDA Quality and Yield Grades. Strip loins were identified on the right side of a subset of carcasses and were collected during the fabrication process. Strip loins were then transported to Oklahoma State University where they were allowed to age for 7-d at 35 to 39^{o}F. Following the 7-d aging period a 1 in steak was removed from each loin strip and immediately frozen at approximately –110°F. Testing steaks were thawed overnight at 32°F, cooked in an impingement oven to an internal temperature of 158°F and allowed to cool to room temperature prior to shear force evaluation. Six, 1.25 cm core samples were removed from each steak and shear force was evaluated using a Universal Instron Testing Machine with a Warner-Bratzler shear head attachment.

Statistical Analysis. Data were analyzed as a randomized complete block design using the GLM procedure and a least squares model that included block and implant treatment (SAS Inst. Inc., Cary, NC). Pen served as the experimental unit for gain, dry matter intake, and efficiency data, and steer was used as the experimental unit for carcass parameters. Non-orthogonal contrasts were used to compare: 1) control vs implant; 2) steers implanted once vs steers implanted twice; 3) steers implanted twice d 1 vs steers implanted on d 1 and reimplanted on d 94; 4) implant – reimplant vs implant – explant, reimplant.

Results and Discussion

Feedlot Performance. Performance data are presented in Table 1. While previous implant history was unknown, steers that were implanted during the finishing period had an overall 13.5% greater daily gain compared with NC steers. This daily weight gain benefit resulted in a 6.21% (72 lb) advantage in final BW and a 6.23% (46 lb) advantage in hot carcass weight for implanted steers compared with NC. Overall, implanted steers consumed 5.1% more feed than non-implanted steers with the majority of the advantage being observed from d 85 to the end of the experiment. Implanted steers also more efficiently (8.0%) converted DMI to daily gain compared with NC. Steers implanted twice had a 6.5% advantage in overall ADG compared with R_1 steers. Among implanted steers, the number of implants administered had no effect on DMI, however steers that received two implants converted feed to gain more efficiently (6.2%) than R_1 steers.

A preplanned comparison of this experiment was to determine the effects of two initial implants as compared with the more traditional method of reimplanting mid-way through the finishing period. For this experiment, this comparison yielded no differences for daily gain, DMI or feed efficiency. Another objective of this experiment was to evaluate the pay-out period of a moderate estradiol + TBA implant. This was accomplished by removing the initial implant (explanting) and replacing it with a new implant of the same combination (R_1ER_{94}) and comparing performance results with those of the R,R_{94} steers. Daily gain of (R_1ER_{94}) steers was decreased by 12.5% from d 85 to the end of the experiment compared with steers in which the original implant was not removed. Explanting had no effect on DMI and tended to decrease feed conversions from d 85 to the end of the experiment.

Table 1. Feedlot performance least squares means by implant regime for finishing steers

	Implant regimen[a]						
Item	NC	R_1	$2R_1$	R_1R_{94}	R_1,ER_{94}	SE[c]	Effect[b]
Steers	30	29	29	30	30		
Weight, lb							
Initial	637	637	639	639	639	4	--

Final	1164	1207	1239	1264	1233	15	CI, 1v2
Daily gain, lb/d							
0-84	3.17	3.39	3.63	3.57	3.66	.07	CI, 1v2
85-end	3.04	3.33	3.46	3.77	3.35	.13	CI, IRvIER
0-end	3.12	3.37	3.57	3.68	3.50	.09	CI, 1v2
DMI, lb/d							
0-84	18.1	18.6	19.3	18.7	19.1	.37	--
85-end	20.8	22.3	22.1	22.4	21.8	.42	CI
0-end	19.6	20.6	20.6	20.7	20.6	.26	CI
Feed:gain							
0-84	5.71	5.46	5.29	5.26	5.21	.50	CI
85-end	6.90	6.71	6.33	5.95	6.49	.60	--
0-end	6.33	6.13	5.78	5.65	5.88	.40	CI, 1v2

[a]Implant regimen: Control = no implant; R_1 = a single implant on d 1; $2R_1$ = two implants on d 1; R_1,R_{94} = a single implant on d 1 and a single reimplant on d 94; R_1,ER_{94} = a single implant on d 1, removal of the initial implant and reimplant on d 94

[b]Effect: CI = control vs all implanted steers (P<.05); 1v2 = steers implanted once vs steers implanted twice (P<.05); 2d1vIR = two initial implants vs implant d 1, reimplant d 94 (P<.05); IRvIER = implant, reimplant vs implant, explant - reimplant (P<.05)

[c]SE = standard error of the least squares means

Carcass Characteristics (Table 2). Heavier final live weights of implanted steers resulted in 46 lb more carcass weight compared with NC. Implanting in this experiment had no effect on external fat thickness, ribeye area, percentage of internal fat, final yield grade, marbling score, lean or skeletal maturity, and liver abscesses. Steers implanted twice had heavier carcasses (24 lb, a 3% advantage) with greater internal fat (2.60 vs 2.32%) than steers implanted once. When evaluating the effects of implant pay-out on carcass merit, explanting on d 94 tended to decrease 12^{th} rib fat thickness (P=.08), while increasing (P=.05) percentage of internal fat compared with R_1R_{94} steers. Two implants on d 1 resulted in less external fat as well as a tendency to have greater internal fat compared with R_1R_{94} steers. Greater external fat in the R_1R_{94} steers resulted in a higher numerical final yield grade compared with $2R_1$ steers. Steers given two implants on d 1 tended to have the lowest percent Choice carcasses of all treatments; however no differences were observed for implant regime effects on marbling score or percentage of U.S. Choice.

The final carcass measurement in this experiment was tenderness, which was measured objectively by Warner-Bratzler shear evaluation. No effect of implant regime was observed; however, implanting in general increased the pounds of force required to shear a 1.25 cm core by 1.65 lb compared with NC. While not different from other implanted treatments, steers re-implanted on d 94 had the highest numerical shear force and the greatest percentage tough of all treatments. When comparing individual treatments rather than planned contrasts, the R_1R_{94} (12.25 vs 9.47 ± .70; P<.01) and R_1ER_{94} (11.39 vs 9.47 ± .70; P=.04) treatments were different from NC, respectively. The R_1R_{94} treatment also differed from the R_1 treatment (P=.03); however, R_1 and $2R_1$ were not different from negative controls. These results might suggest that implants later in the finishing period had a greater effect on tenderness than implanting early in the feeding period.

Table 2. Least squares means for carcass characteristics stratified by implant regime for steers fed 180 d							
	Implant regimen[a]						
Item	NC	R_1	$2R_1$	R_1R_{94}	R^1ER_{94}	SE[c]	Effect[b]
Carcasses	30	29	29	30	29		
Hot carcass wt, lb	737	764	785	800	781	9	CI, 1v2
12th rib fat, in	.50	.50	.52	.62	.53	.03	2d1vIER
Adj 12th rib fat, in	.57	.57	.57	.68	.62	.03	2d1vIER
Ribeye area, in²	13.14	13.31	14.12	13.76	13.26	.33	--
REA/100 lb HCW	1.78	1.74	1.80	1.72	1.70	.20	--
KPH, %	2.73	2.32	2.70	2.40	2.71	.11	1v2, IRvIER
Yield grade	2.40	2.38	2.40	2.87	2.63	.13	2d1vIR
Lean maturity[d]	A^{49}	A^{56}	A^{50}	A^{53}	A^{52}	2.54	--
Skeletal maturity[d]	A^{51}	A^{48}	A^{55}	A^{50}	A^{52}	2.73	--
Marbling score[e]	SM^{09}	SL^{99}	SL^{71}	SL^{86}	SL^{81}	13.27	--
Quality grade							
PremCh, %	16.7	17.2	6.9	10.0	10.3	4.5	--
Low Ch, %	33.3	24.1	24.1	36.7	31.0	5.6	--
Select, %	43.3	51.7	65.5	50.0	55.2	8.2	--
Standard, %	6.7	6.9	3.5	3.3	3.5	1.9	--
Liver score[f]	.27	.24	.17	.53	.39	.15	
Shear force, lbf							
Steaks	14	14	5	10	11		
Aged, 7 d	9.47	10.20	10.62	12.25	11.39	.99	CI
% tough[g]	28.6	50.0	40.0	80.0	63.6	20.1	--

[a]Implant regimen: Control = no implant; R_1 = a single implant on d 1; $2R_1$ = two implants on d 1; R_1,R_{94} = a single implant on d 1 and a single reimplant on d 94; R_1,ER_{94} = a single implant on d 1, removal of the initial implant and reimplant on d 94

[b]Effect: CI = control vs all implanted steers (P<.05); 1v2 = steers implanted once vs steers implanted twice (P<.05); 2d1vIR = two initial implants vs implant d 1, reimplant d 94 (P<.05); IRvIER = implant, reimplant vs implant, explant - reimplant (P<.05)

[c]SE = standard error of the least squares means

[d]Maturity score: "A"=100, between 9 and 30 mo of age

[e]Marbling score: SL=300, SM=400

[f]Liver score: 0=a normal liver, 1="A" (Elanco System for Grading Abscessed Beef Cattle Livers)

[g]Percent tough=determined by percentage of steers in treatment with shear value exceeding 10 lbf (Shackelford et al., 1991)

Implications

Implanting in this experiment enhanced rate (13.5%) and efficiency (8.0%) of gain. It is important to realize that some degree of implantation is necessary to maintain our current level of production. However, the aggressiveness with which we use implants also directly affects our final product, which is not conducive with consumer preference and may have a negative effect on demand. With this in mind we should work to develop implant strategies that maintain production without compromising demand.

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