Effects of Repetitive Use of Hormonal Implants on Beef Carcass Quality, Tenderness, and Consumer Ratings of Beef Palatability

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Abstract

Effects of repetitive use of anabolic implants on beef carcass quality, tenderness, and consumer ratings for palatability were investigated using crossbred steer calves (N=550) obtained from five ranches. Steers from each ranch were randomly allocated to one of ten different lifetime implant strategies or to a negative control group. Cattle were implanted at some or all of five phases of production (branding, weaning, backgrounding, feedlot entry, or re-implant time). Non-implanted steers produced carcasses with higher ($P < 0.05$) marbling scores than steers implanted two, three, four, or five times. Steers implanted twice during their lifetime produced carcasses with higher ($P < 0.05$) marbling scores than did steers receiving four or five lifetime implants. Implanting steers at branding, weaning, or backgrounding production stages did not affect marbling scores. Steaks obtained from carcasses in the control group had lower ($P < 0.05$) shear force values and were rated by consumers as more desirable ($P < 0.05$) for tenderness like/dislike than steaks obtained from carcasses in all other treatments. Implanting steers at branding or weaning did not affect steak shear force values, consumer ratings for like/dislike of steak tenderness, or percentage of consumers rating overall eating quality of steaks as satisfactory. Implanting steers at backgrounding increased ($P < 0.05$) steak shear force values, but did not influence consumer ratings for like/dislike of steak tenderness or percentage of consumers rating overall eating quality of steaks as satisfactory. Consumer ratings for like/dislike of tenderness were similar for steaks from steers implanted two, three, four, or five times during their lifetimes. Steaks from non-implanted steers were rated as more desirable ($P < 0.05$) for overall eating quality than steaks from steers implanted two, three, four, or five times. All implant strategies increased ($P < 0.05$) hot carcass weight of steers compared to the control group. Implants increased ($P < 0.05$) ribeye area and decreased ($P < 0.05$) estimated percentages of kidney/pelvic/heart fat. Implant strategy did not affect dressing percentage or adjusted fat thickness. Our findings suggest that beef quality and palatability characteristics were influenced by lifetime implant protocols.

Introduction

Growth promoting implants are used routinely by U.S. beef producers to increase rate and efficiency of growth in cattle. Hormonal implants are approved for use in cattle of all ages and may be used to enhance growth during the suckling, growing, and finishing phases of production. The benefits of using implants to improve growth performance of cattle are well documented. However, research suggests that "aggressive" and/or repetitive use of implants may be detrimental to beef carcass quality and tenderness (Morgan, 1997; Roeber et al., 2000). This study was designed to examine the effects of administering growth promoting implants, at sequential stages of production, up to five times during the lifetime of steers, on carcass quality traits, beef tenderness, and consumer ratings of beef palatability.

Wyoming | Idaho | Texas | Wyoming | Branding | Weaning | Backgrounding | Finishing | Carcass Traits | Shear Force | Consumer Panel

Materials and Methods

Table 1. Experimental design

Production Phase	Duration of Phase	Experimental treatment group 1	2	3	4	5	6	7	8	9	10	11
Branding	129-166 d	NO	NO	NO	NO	C	NO	C	C	C	C	C
Weaning	45-48 d	NO	NO	NO	NO	NO	RA	NO	NO	RA	RA	RA
Backgrounding	64-102 d	NO	NO	RA	S	S	S	RA	S	RA	S	S
Feedlot entry	56-70 d	NO	S	S	S	NO	S	S	S	S	S	RV
Re-implant	42-136 d	NO	RV	RV	RV	RV	RV	RV	RV	RV	RV	RV
No. of steers (n)		50	50	50	50	50	50	50	50	50	50	50
No. of implants		0	2	3	3	3	4	4	4	5	5	5

Abbreviations used: NO = no implant; C = Synovex-C® (10 mg estradiol benzoate, 100 mg progesterone) ; RA = Ralgro® (36 mg zeranol); S = Synovex-S® 20 mg estradiol benzoate, 200 mg progesterone); RV = Revalor-S® (24 mg estradiol benzoate, 120 mg trenbolone acetate).

Cattle Management

✓At branding, male calves at each of the five ranches were castrated and randomly assigned to treatment groups, in a balanced fashion.

✓At weaning, steers from all ranches were transported to the same commercial feedlot for growing and finishing and were harvested when they attained 12 to 16 mm of fat thickness over the longissimus muscle at the 12th rib.

Carcass Data Collection

✓A panel of three Colorado State University personnel independently recorded measurements/assessments of USDA quality and yield grade factors.

Tenderness Measurements

✓Warner-Bratzler shear force values, after 14 and 21 d of postmortem aging, were obtained for strip loin steaks (2.54 cm) cooked to a final internal temperature of 70°C.

Consumer Sensory Evaluations

✓A total of 25 consumer panel evaluation sessions were conducted that included a total of 489 consumers.

✓Each consumer evaluated steak samples from each of the 11 treatment groups. Strip loin steaks (2.54 cm) were cooked to a final internal temperature of 70°C.

✓Consumers rated each steak sample for like/dislike of tenderness, flavor, and juiciness using nine-point, end-anchored hedonic scales and were asked if they were satisfied (yes or no) with the overall eating quality of each sample.

Statistical Methods

✓Analyses of carcass, shear force, and consumer response data were conducted using the least squares, mixed model procedure of SAS, and when appropriate, multiple comparisons of treatment means were performed using paired comparison t-tests.

✓Frequency distributions of USDA quality grades among treatment groups were compared using the Chi-square test of SAS.

✓Contrasts were partitioned in the analysis of variance models to compare effects of implanting at branding, weaning, and backgrounding in mixed model analysis of SAS.

Results and Discussion

In general, the number of implants administered to steers (Table 2) affected ($P < 0.05$) marbling scores of carcasses, whereas, timing of implanting did not (Table 3). Additionally, the percentage of carcasses grading upper two-thirds Choice and Prime was decreased ($P < 0.05$) as a result of increasing the number of implants administered to steers (Table 2).

Steaks obtained from steers in the control group had lower ($P < 0.05$) mean shear force values than steaks obtained from steers in all other treatments (Table 2). Implanting at branding or weaning production phases did not affect shear force values; however, implanting at the backgrounding production phase increased ($P < 0.05$) mean shear force values (Table 3).

Steaks from non-implanted steers had more desirable ($P < 0.05$) consumer ratings for like/dislike of steak tenderness, juiciness, and flavor and percentage of satisfied consumers with respect to overall eating quality than steaks produced from implanted steers (Table 2). Implanting steers at branding, weaning, or backgrounding did not affect consumer ratings of steak tenderness, flavor, or juiciness (data not shown). Only a limited amount of information is available concerning the effects of implant strategies on consumer sensory evaluations of beef palatability traits. Roeber et al. (2000) reported implanting steers decreased consumer ratings for steak tenderness, but did not influence consumer ratings for like/dislike of steak juiciness and flavor and overall steak like/dislike.

Mean hot carcass weights for implanted steers were between 8.9 to 12.6% heavier ($P < 0.05$) than those for control steers (Table 2). Implanting steers increased ($P < 0.05$) ribeye area 11.2 to 13% and decreased ($P < 0.05$) estimated percentages of kidney/pelvic/heart fat, but did not affect dressing percentage or adjusted fat thickness of carcasses (data not shown).

Table 2. Least squares means of carcass traits, Warner-Bratzler shear force values, and consumer sensory responses by number of implants administered

Trait	Number of implants administered 0	2	3	4	5	SEM
Marbling score[a]	538^{x}	485^{y}	461^{yz}	447^{z}	447^{z}	24.1
% Upper two-thirds Choice and Prime	54.0^{x}	36.0^{xy}	25.3^{yz}	24.7^{yz}	21.4^{z}	
Hot carcass wt., kg	326^{z}	355^{y}	363^{xy}	364^{xy}	367^{x}	4.01
Overall shear force, kg[b]	3.54^{z}	3.97^{y}	4.27^{x}	4.12^{xy}	4.19^{xy}	0.15
Tenderness L/D[c]	3.15^{z}	3.79^{y}	3.97^{y}	3.88^{y}	3.93^{y}	0.16
Flavor L/D[c]	3.34^{z}	3.62^{y}	3.76^{y}	3.77^{y}	3.82^{y}	0.09
Juiciness L/D[c]	3.54^{z}	3.91^{y}	4.10^{y}	4.10^{y}	4.13^{y}	0.12
% satisfaction, overall eating quality	73.6^{y}	65.0^{z}	63.2^{z}	63.5^{z}	63.5^{z}	3.08

[a]Adjusted to a common fat thickness, 300 = slight, 400 = small, 500 = modest.
[b]Repetitive measurements of shear force values, after 14 and 21-d aging periods.
[c]Consumer like/dislike ratings where: 1 = like extremely and 9 = dislike extremely.
[wxyz]Means in the same row lacking a common superscript letter differ ($P < 0.05$).

Implications

Our findings suggest that lifetime implant protocols affected both the eating quality and tenderness of beef and emphasize the importance of choosing implant programs based on specific marketing targets for cattle. Producers retaining ownership of steer calves, destined for marketing on a "quality" oriented value-based grid, may choose not to implant cattle or delay implant administration to cattle until backgrounding or feedlot entry in order to minimize the risk of detrimental effects on beef quality associated with "aggressive" lifetime implant strategies. The impacts of lifetime implant protocols on beef acceptability may be of particular interest to vertically coordinated branded beef programs interested in maximizing quality, consistency, and tenderness of their beef products.

Table 3. Probabilities of significance of contrasts for means of implant strategies differing by phase of production

Implants received	Least squares means: Branding No	Branding Yes	Weaning No	Weaning Yes	Backgrounding No	Backgrounding Yes	*P* of contrasts: Branding No/Yes	Weaning No/Yes	Backgrounding No/Yes
Marbling[a]	453	451	451	451	485	460	0.825	0.936	0.087
Overall shear force, kg[b]	4.26	4.10	4.12	4.11	3.95	4.33	0.104	0.958	0.016
Hot carcass wt.,kg	367	364	361	369	356	365	0.302	0.022	0.078

[a]Adjusted to a common fat thickness, 300 = slight, 400 = small, 500 = modest.
[b]Repetitive measurements of shear force values, after 14 and 21-d aging periods.

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