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Impact of Castration and Zeranol Implants on Bullocks: I. Behavior, Growth and Carcass Traits

[1]Hawkins, E. W., [2]R. A. Field, [3]L. E. Orme, [4]R. E. Dyer and [5]D. K. Lunt
[1]Department of Nutrition, Dietetics, and Food Science, Brigham Young University, Provo, UT 84602
[2]Emeritus status, Department of Animal Science, University of Wyoming, Laramie, WY 82071
[3]Emeritus status, Department of Animal Science, Brigham Young University,
Provo, UT 84602 [4]385 West 1060 South, Orem, UT 84058
[5]Texas A&M University Agricultural Research Center, McGregor, TX 76657

Abstract: The effects of Zeranol implants on behavior, feedlot performance and carcass traits were studied using 95 young intact and 98 castrated bovine males. The intact males were heavier at slaughter, (515 vs. 468 kg; P<.005) had less backfat, (0.81 vs. 1.11 cm; P<.005), larger loin eye area, (89.0 vs 76.8 cm^2; P<.005), more desirable USDA yield grades (2.11 vs. 2.92; P<.005), a higher percentage of edible lean cuts (81.5 vs. 80.5), and less bone and fat trim (16.4 vs. 18.9 kg) than steers. Steers exhibited more marbling, (small$^+$ vs. slight) a higher USDA quality grade, and reached market condition 5 d earlier than the intact males. Castration had a much greater effect on mean carcass cutout than did implant treatment. Whereas implant treatment affected percentage of blade and top sirloin, castration increased yield of every primal and subprimal cut studied except for lean trim and sirloin tip. Behavior characteristics of implanted and control bulls and steers were also studied. Implantation made bulls and steers more docile. Libido measurements were also lower for the implanted bulls as compared to non-implanted intact males. These data confirm that castration and implants have significant effects on behavior, growth and carcass characteristics of young male bovines.

Key words: Beef Cattle, Growth, Implants

Introduction

Consumer concerns over fat and cholesterol have increased producer interest in lean beef production because consumption of beef has decreased both in absolute terms as well as relative to competing proteins. Poultry meats have increased in per capita consumption because they are perceived to be leaner than beef and they are priced lower. The livestock industry is trying to meet these challenges by providing consumers with wholesome, palatable and nutritious meat that will have minimum fat and that can be purchased at a competitive price.

Intact males can produce leaner beef more efficiently than steers. Reviews by Field (1971) and Seideman *et al.*, 1982 documented advantages such as increased rate of gain, greater feed efficiently and leaner carcasses for bulls when compared to steers. However, considerable resistance to the production of bulls persists in the United States, primarily due to management problems (Mies, 1982 and Oltjen 1982); slaughter and dressing difficulties; and lower quality grades (Binger, 1982). Cattlemen could take advantage of the growth potential and efficiency of young bulls by feeding high concentrate diets to weaning bulls and slaughtering before 16 mo of age.

Hormonal implants (estrogens) have been shown to increase rate of gain and feed efficiency. Baker and Arthaud (1972) summarized the data from 46 comparisons of hormone treatments to bulls and found inconsistent responses to rate of gain or carcass grade due to hormone treatment. Implanting with an estrogen-like compound such as Ralgro™ (Zeranol) shortly after birth had variable effects on growth rate and feed efficiency (Greathouse *et al.*, 1983). Zeranol implantation shortly after birth reduced masculinity and decreased behavior problems with bulls (Greathouse *et al.*, 1983; Baker and Gonyou 1984). However, post-weaning implantation of young bulls during the feedlot period had minimal affect on performance and carcass characteristics (Price *et al.*, 1983). Greathouse *et al.*, 1983, and McKenzie (1984) reported that young bulls implanted shortly after birth had improved performance, behavior and carcass characteristics when compared to non-implanted bulls fed for slaughter.

The objectives of this study were to examine the effect of Zeranol implants on behavior, growth and carcass characteristics of young bulls and steers.

Materials and Methods

Cattle Management: One hundred ninety three male calves from two ranches in central Utah were used in this study. The calves were predominantly Hereford, Hereford x Angus or Charolais crossbreds. They were individually weighed and branded at 2 to 4 mo of age, and assigned to one of four groups based on weight and breed so that similar weights and breeds were found in each group. The four groups were: 1) control steers, 2) Zeranol implanted steers, 3) control bulls and 4) Zeranol implanted bulls. All calves were branded and injected with various vaccines. Groups 1, 2, and 4 were castrated and/or implanted concurrently with weighing and branding. Zeranol treated groups received 36 mg of Zeranol according to manufacturer's instructions. All calves remained at their mother's side until they were shipped to the feedlot in the fall.

Feedlot Facilities: Upon arrival at the feedlot, the calves were again vaccinated and given vitamin A, D and B12 shots. The calves from both ranches were allowed to mingle in two pens approximately 30 m wide by 61 m deep with 30 m of feed bunk space. Calves were fed alfalfa and grass hay *ad libitum* until they adjusted to their new environment. They were then placed on a starter ration. Three weeks after arrival, the bacterin injections were repeated, and grubicide treatments were administered.

Of the original 215 male calves assigned to this study, 19 were eliminated prior to the beginning of the study because of death, morbidity or for having been castrated and erroneously classified as intact. After the calves had adjusted to the new surroundings and feed, the hay was removed from the ration and the calves were fed a 63% concentrate ration for 3 months. Then the concentrate level gradually increased to 84% for the remainder of the trial. The cattle were fed twice daily and any day-old feed was removed and the weight estimated to adjust the daily feed records.

The study began approximately 4 weeks after arrival of the calves. Each of the four treatment groups were individually weighed for two consecutive days and divided into two equal replications per group based on weight and estimate of breed (Table 1). The eight resulting sub-groups were assigned to pens separate from other areas of the feedlot to help minimize antagonistic behavior or disturbances caused by cattle movement. The pen order was staggered so as not to have two bull pens together and the pens were rotated at 28 day intervals at the time of weighing but the original group order was maintained (Table 2). Three animals had to be eliminated because of death or morbidity, one each from the implant bull, and implant steer and control bull groups. The treatment groups that were implanted at the time of branding were reimplanted at the beginning of the feeding trial and 56 days later with 36 mg of Zeranol. Hip height measurements and individual scrotal measurements were taken on day 28 and 140 of the trial.

Behavioral Observations: Each Saturday during the 19 weeks of the study, each pen was observed for 30 minutes for sexual, antagonistic, ingestive, and restive behaviors. Observations began at 1:00 p.m. so disturbances were at a minimum. Preliminary observations indicated there was also a wide variety of behavioral activities from 1:00 to 5:00 p.m. Adequate feed was available during this time. No movement of vehicles or personnel was allowed in proximity to the pens or alleys during the observation time.

A tower was constructed of pipe and corrugated metal to make a blind. The floor of the blind was approximately two m above ground level and provided an optimal view and prevented the observer from being too obvious to the cattle. The tower was portable and fit on the back of a pickup. The pickup and tower were driven around the pens and alleys for 7 days prior to the first observation to allow the cattle time to adjust to its presence. During the training and observation periods the pickup was driven in a feed alley located approximately 5.5 m from the pens with the cattle alley located between the pens and the pickup.

Two pens adjacent to each other were randomly selected as a starting point and were observed simultaneously for 30 minutes. The blind was then moved to the next two pens. Five minutes were allowed between moving the vehicle and the starting of the next observation. This allowed the cattle to return to their normal activities if they had been disturbed.

Each pen of cattle was observed for all occurrences of fighting, bunting, homosexual mounting, flehmens and masturbations. Whenever possible, the aggressor and aggressed were determined for the bunting and fighting bouts. Fight winners and losers were also recorded when a win/lost encounter occurred. The individuals involved in homosexual mountings were recorded as either the mounter or the mounted.

Scans of the pens were made at the beginning of the observation and at each 5 minute interval to record the number of animals eating, drinking, resting (lying down either asleep or awake), and standing (while not eating or drinking) as an estimate of the time spent in these activities.

Libido Test: A libido test was conducted prior to slaughter for both the bulls and steers. Eight stanchions were constructed in a pen approximately 112 m^2. The sides of the stanchions were made of pipe 0.7 m high, 1.6 m long and 0.8 m apart. Four yearling heifers were restrained in the stanchions by halters tied to the front of the fence. After the heifers were restrained, the pen of animals to be tested was moved to a pen adjacent to the heifers. The cattle were given 15 min to adjust to the surroundings. The implanted bulls in the first replication were evaluated first, followed by the implanted steers, the control bulls and the control steers. The animals of the second replication were tested in the same order. Two animals were placed in the pen with the heifers and observed for 10 minutes by two observers. Each observer watched one animal and recorded the number of mounts without an erection (having a pelvic thrust), actual services, flehmens, and masturbations. The amount of time that the animals spent fighting or within 2 m of the heifers was also recorded. The two animals to be tested were selected in such a manner as to minimize disturbance and excitement as much as possible.

Slaughter Measurements: Bulls and steers were slaughtered at 12 to 15 mo of age when an estimated USDA yield grade of 2 was attained. The cattle were individually weighed at the feedlot and also when they arrived at the packing plant. The cattle were shipped 56 km via a livestock semi-trailer to the Deseret Meat Packing plant in Spanish Fork, Utah. All bulls were transported in compartments which contained only individuals of the same lot. All cattle were slaughtered approximately 2-3 h after arrival at the plant. Testicles from the bulls were removed at slaughter and individually weighed. Carcasses were split into halves on the kill floor, and ear tags were kept with individual carcasses for identification.

Carcass Characteristics: Carcasses were placed in a cooler at -2.2 C for 24 h before each side was ribbed. USDA quality and yield grade were measured at this time. The chilled right half of each carcass was individually weighed and used as the denominator in calculating primal and sub-primal cut percentages. All primal and sub-primal cuts were made using International Meat Purchasing Specifications (IMPS) and trimmed to 8 to 12 mm of external fat. The chuck was removed by cutting between the 5th and 6th ribs and at the lateral condyle of the forearm. The oven-ready rib with the short ribs removed was made leaving approximately 2.5 cm of tail at each end. The tenderloin was removed from the hind quarter in its entirety. The strip loin and top sirloin were boned before weighing. The strip loin was cut with approximately 5 cm of tail remaining. The round was divided into the following boneless pieces: 1) sirloin tip, 2) top or inside round and 3) bottom or outside round. Lean trim from the above primal or sub-primal cuts along with lean trim from the foreshank, plate, flank and hind shank was classified as edible lean. The kidney knob fat was individually weighed and included in the fat and bone trim. All individual cuts, lean and fat trim were weighed and recorded for each carcass.

Statistical Analysis: Statistical analysis for the data was made using the Rummage II system of the Statistical Department of Brigham Young University, using 1984 version. Analysis of variance, and Pearson's simple correlation tests were utilized. Factors included in the analysis of variance were: treatment, sex, and pen. The treatment by sex interaction was also included in the model.

Results and Discussion

Live Animal Performance: Means for feedlot performance of Zeranol implanted and control bulls and steers are given in Table 3. There was no difference in branding weight at the beginning of the test. Although not significant ($P>.05$) the implanted bulls and steers at the end of the suckling period (beginning feedlot weight) were heavier than non-implanted controls. The non-implanted steers had significantly ($P<.05$) lower off test weights than the other three groups. The feedlot test gain and feedlot ADG was higher for bulls than for steers and for implanted animals than for controls ($P<.05$). All cattle in this study were fed by pen. Efficiency was calculated by pen and therefore not analyzed statistically. The control steers were less efficient converters. The implanted bulls converted 5.6:1 as compared to 6.1:1 for the control bulls. The feed conversion for the implanted steers was 5.8:1 as compared to 6.2:1 for the control steers ($P<.05$).

Animal Behavior: During the 19 weeks of this study each treatment and pen was observed for 30 minutes for sexual, antagonistic, ingestive, and restive behaviors. No significant sex or treatment difference was found in this study for the time spent eating, drinking, resting or standing. However the control bulls were much more responsive to out of pen disturbances. Each pen of cattle was observed for the behavior traits listed in Table 4. Whenever possible, the aggressor and aggressed were identified. The fight winners and losers were also recorded. The control bulls were significantly more aggressive (P<.05) than the implanted steers for mounts, bunts and fights. The results of the libido test are listed in Table 5. The control bulls were found to be significantly different from implanted bulls (P<.05) in attempts to breed, in the number of actual services as well as in total mounts and services. For all other traits observed, differences were not noted.

Slaughter Procedure and Carcass Characteristics: Slaughter time was pre-determined when live animals were estimated to have 7-12 mm of fat at the last rib. Carcass weight and traits used to determine USDA quality and yield grade are shown in Table 6. Bull carcasses were heavier than those from steers. The carcasses from the control steers were significantly (P<.05) lighter than those for all other treatments. The yield of hot carcass was higher for the bulls than the steers. When comparing hot carcass yield within treatment the implanted bulls and steers tended to

Table 1: Experimental Design

	Bulls		Steers	
	Implant	Control	Implant	Control
Replication 1	23	23	23	24
Replications 2	27	22	24	26
Total	50	45	48	50

Table 2: Pen Assignments

Pen 1	Pen 2	Pen 3	Pen 4	Pen 5	Pen 6	Pen 7	Pen 8
Implant	Implant	Control	Control	Implant	Implant	Control	control
Bulls	Steers	Bulls	Steers	Bulls	Steers	Bulls	Steers
Rep. 1	Rep. 1	Rep. 1	Rep. 1	Rep. 2	Rep. 2	Rep. 2	Rep. 2

Initial pen assignments. Cattle were rotated to the next highest pen each 28d

Table 3: Means for Feedlot Performance of Zeranol Implanted and Control Bulls and Steers (kg)

	Bulls		Steers			Bull	Imp	Trt
					vs	vs		x
Item	Imp.	Con	Imp	Con	SD[a]	Steer	Con	Sex
Number	50	45	48	50				
branding Wt.	84	81	84	81	5.59	NS	NS	NS
Day 0 Feedlot Wt.	270	266	257	249	10.18	*	NS	NS
Pre-test Gain	186	183	176	168	8.95	NS	*	NS
Pre-test ADG	0.87	0.85	0.82	0.79	0.36	NS	*	NS
Final Wt.	519	508	511	468	14.54	*	*	NS
Feedlot Gain	249	242	254	218	11.09	*	*	NS
Feedlot Daily Intake[b]	7.9	8.3	7.7	7.7				
Feedlot Adg	1.41	1.37	1.37	1.23	0.07	*	*	NS
Feed Conversion[b]	5.6	6.1	5.8	6.2				

a: Pooled standard deviation of the observation
b: Calculated on a group basis without statistical measurement or analysis
*: Differences between bulls vs steers; implanted animal svs control animals or the treatment x sex interaction are significant at the P<0.05 level

Table 4: Means for Pen Observation of Behavioral Traits

	Bulls		Steers	
Item[d]	Implant	Control	Implant	Control
Total Mounts	0.81[b]	3.79[a]	0.55[b]	1.18[b]
Total Bunts	5.17[c]	13.91[a]	3.72[c]	8.04[b]
Total Fights	2.58[b]	8.85[a]	0.94[c]	3.53[b]
Flehmens	1.81[b]	3.82[a]	0.04[c]	0.02[c]
Masturbations	0.04[b]	0.47[a]	0.0[b]	0[b]

a,b,c figures in the same row with different superscripts differ significantly (P<0.05). d : Average per head per 30 min observation

be higher than their control or non-implanted counterparts. The carcasses of bulls were significantly (P<.05) leaner than their contemporary steer carcasses as observed from loin eye area, fat thickness, percent KPH fat and USDA yield grade. When comparing implanted and non-implanted bulls the control bull carcasses were slightly leaner for the above traits, followed by the implanted bull carcasses, implanted steers and control steers. However, when marbling and final USDA quality grades were evaluated, the steer carcasses, both implanted and control, graded significantly higher (P<.05) than the bulls. When loineye area was put on a 100 kg of carcass weight basis, implantation decreased loineye area because loin eye does not increase proportionally as carcass weight increases (Table 6). Implanted bulls had more subcutaneous fat than the control bulls. Marbling for the steer treatments was Small minus and Small plus, respectively. Loin eye area, fat thickness at the 12th rib and USDA yield grade were in favor of the bull carcasses when compared to steer carcasses with the control bull carcasses having a slight advantage over implanted bulls. Cut out percentage for the bull carcasses exceeded that of steer carcasses 81.5% to 80.1% respectively as shown in Table 7. Significant differences (P<.05) for certain primals and sub-primals between bull and steer carcasses existed. The arm chuck, blade chuck and bottom round made up a larger percentage of the carcass in bulls than in steers. Percentage of lean trim, kidney-pelvic fat and bone and fat trim waste were significantly higher for the steers than bulls. The content of lean trim was not standardized to a specific amount or percent of lean. The weight of lean trim from the steer carcasses was higher due to increased amount of fat since the steer carcasses were fatter. The percent KPH fat in Table 6 was an estimated figure, whereas the KPH fat percent listed in Table 7 was calculated from the actual carcass weight. Percent KPH for the bull carcasses was 26% less than steer carcasses and 12% less total bone and fat waste. Table 8 shows there was a significant sex difference between bulls and steers for the weight of most primal and sub-primal cuts. Implantation did not significantly modify the weights and percentages of primal and subprimal cuts listed in Table 8.

Table 5: Means of Libido Test Behaviors

	Bulls		Steers	
Item[d]	Implant	Control	Implant	Control
Mounts W/O an Erection	1.99a	4.09a	1.4a	1.25a
Attempts to Breed	1.47b	0.62a	0.75b	2.32b
Actual Services	2.04b	6.19a	0c	0c
total Mounts and Services	5.49b	10.89a	2.15c	3.57bc
Flehmens	0.16a	0.58a	0.00a	0.00a
Tiem with Heifer (min)	6.81ac	8.46a	5.85bc	7.49ac
Fighting time (min)	0.46ab	0.60a	0.07bc	0

a,b,c: Figures in the same row with different superscripts differ significantly (P<0.05)
d: Average per head per 10 min observation

Table 6: Means of Carcass characteristics for Zeranol Implanted and Control Bulls and Steers

	Bulls		Steers			Bull vs	Imp vs	Trt x
Item	Imp.	Con	Imp	Con	Sd[a]	Steer	Con	Sex
Number	50	45	48	50				
Hot Car Wt kg	324	315	311	285	6.48	*	*	*
Hot Car Yield %	62.4	61.7	61.6	60.9	0.10	*	NS	NS
Loin eye area (LEA), cm^2	86.5	92.3	78.7	74.8	0.10	*	NS	*
Lea/100kg Carcass Wt cm	26.8	29.5	25.4	26.6	0.19	*	*	NS
Backfat, cm	0.89	0.74	1.07	1.32	0.06	NS	NS	NS
Backfat/100kg carcass Wt cm	0.28	0.24	0.35	0.47		*	NS	NS
Percent Kidney, Pelvic & Heart Fat	2.4	2.4	3.1	3.4	0.06	*	NS	NS
Yield Grade	2.4	1.9	2.9	2.9	0.52	*	*	NS
Marbling[b]	12.2	12.2	14.3	15.7	0.70	*	NS	NS
carcass Maturity[c]	1.8	1.9	1.4	1.2	0.03	*	NS	NS
Quality Grade[d]	5.9	5.8	7.1	7.6	0.15	*	NS	NS

a) Pooled Standard Deviation of Observation
b) 11.0=slight, 14.0 = small, 17.0 = modest
c) 1.0 = A-, 1.5 = A (-), 2.0 = A.
d) 5.0 = Select, 6.0 = Select +, 7.0 = Choice, 8.0 = Choice (o).
* Differences between bulls vs steers; implanted animal svs control animals or the treatment x sex interaction are significant at the P<0.05 level.

Table 7: Means for Percent Carcass Cutout of Zeranol Implanted and Control Bulls and Steers

	Bulls		Steers			Bull vs	Imp vs	Trt x
Item	Imp.	Con	Imp	Con	Sd[a]	Steer	Con	Sex
Number	50	45	48	50				
% Cut out Yield	81.1	81.9	79.7	80.5	0.02	*	NS	NS
% Arm Chuck	8.3	8.7	8.2	8.4	0.006	*	*	NS
% Blade Chuck	15.2	14.9	13.2	12.8	0.012	*	NS	NS
% Rib	6.0	6.1	6.1	6.1	6.1	NS	NS	NS
% Tenderlion	1.5	1.5	1.4	1.5	1.5	*	NS	NS
% Shortloin	3.0	3.0	3.1	3.0	3.0	NS	NS	NS
% Sirloin	3.2	3.2	3.1	3.2	3.2	NS	NS	NS
% Top Round	5.3	5.3	5.1	5.1	5.1	NS	NS	NS
% Bottom Round	5.7	5.8	5.3	5.3	5.3	*	NS	NS
% Sirloin Tip	2.7	2.6	2.6	2.7	2.7	*	NS	NS
%Lean Trim[b]	30.2	30.8	31.8	32.5	32.5	*	NS	NS
% Kidney Knob[c]	2.4	2.4	3.1	3.4	3.4	*	NS	NS
%Bone, Fat, Waste	16.3	16.6	18.4	18.9	18.9	*	NS	NS

a) Pooled Standard Deviation of the Observation
b) Total weight of edible lean and trim (kg) from right side
c) Measured weight of indicated cut or portion per right side carcass cold weight
* Differences between bulls vs steers; implanted animals vs control animals or the treatment x sex interaction are significant at the P<.05 level

Live Animal Performance. Several studies have found it economical to implant calves during the suckling phase (Thomas and Armitage, 1970a,b, Cooper and Kirk, 1982 and Mies, 1982). Mader (1985) reported no differences in response to Zeranol implanting during suckling between bulls and steers. Response to implanting suckling calves has been quite variable. Ralston (1978) found that Zeranol had a non-significant response between implanted and

Table 8: Least Square Means for Primal, Sub-primal Cut weight (kg) and Percentage for Zeranol-Implanted and Control Bulls and Steers

Item	Bulls		Steers			Bull vs Steer	Imp vs Con	Trt x Sex
	Imp.	Con	Imp	Con	Sd[a]			
Number	50	45	48	50				
Blade	23.71	23.49	20.02	18.00	70.7	*	*	*
Arm chuck	13.04	13.44	12.52	11.73	30.9	*	NS	*
Rib wt.	9.36	9.48	9.18	8.41	32.8	*	NS	*
Loin eye	13.4	14.3	12.2	11.7	0.1	*	NS	*
Off feed wt	514	514	506	477	11.2	*	*	*
Kidney Knob	3.90	3.90	4.90	4.94	0.3	*	NS	NS
Fat trim	25.5	25.81	28.0	26.4	1.0	*	NS	NS
Lear trim	47.0	47.5	47.9	46.1	100.2	NS	NS	*
Outside round	8.90	8.92	8.02	7.45	26.1	*	NS	NS
Inside round	8.22	8.02	7.67	7.23	27.1	*	NS	NS
Sirloin tip	4.17	4.04	3.96	3.81	37.4	NS	NS	NS
Sirloin	4.79	4.76	4.64	4.22	20.2	*	NS	NS
tenderloin	2.38	2.35	2.16	2.11	10.0	*	NS	NS
top Sirloin	5.07	5.04	4.75	4.54	9.2	*	*	NS
Strip Loin	13.1	14.3	12.7	12.3	0.3	*	NS	NS
Round %[b]	13.6	13.5	13.0	13.2	0.1	*	NS	NS
Chuck/Loin %[c]	37.2	37.7	35.1	35.1	0.1	*	NS	*
Chuck %[d]	23.4	23.7	21.4	21.3	0.1	*	NS	*

a) Pooled standard deviation of the observation b) Top and bottom rounds added together
c) sum of chucks and loins divided by right side weight
d) Sum of arm and blade chuck divided by right side weight
* Differences between bulls vs steers; implanted animals vs control animals or the treatment x sex interaction are significant at the $P<0.05$ level.

non-implanted bull calves, but it had a positive response between the implanted and non-implanted steer calves. Implanted calves had a greater pre-test gain. The age at which young bulls are implanted has a significant effect on their sexual development. Staigmiller *et al.*, 1985 and Bagley *et al.*, 1989 showed that if Zeranol was administered to young suckling calves there was a reduction of testicular growth and secondary sex characteristics, while weanling bull calves had no reduction in testicular growth or change in sex characteristics. In contrast to our findings, Gregory and Ford (1983) found that implanting yearling bulls had no effect on testicle size or aggressive behavior. Numerous studies have shown that intact males grow faster and are more efficient than steers (Prescott and Lamming *et al.*, 1964 and Ellis *et al.*, 1974). Reviews by Field (1971), and Seideman *et al.*, 1982 showed that bulls had a higher average daily gain and were more efficient than were steers. Newland and Turner (1989) reported implants increases feed conversion by 2%. The feedlot growth during feeding results regarding the response of Zeranol implanted bulls generally agree with those of Corah *et al.*, 1979 and Mies (1982) who reported no significant response.

The age at which young bulls are implanted has a significant effect on their sexual development and could influence many of the items listed in Table 3. For instance, if young bulls are implanted with Zeranol before 2 mo of age, testicular development is inhibited. Implantation after about 7 mo of age does not seem to restrict testicular development. This agrees with studies done by Ralston (1978) and Corah *et al.*, 1979. Results therefore may be attributed to initial ages of implanting, which affects the sensitivity of the young bulls to Zeranol. The Zeranol may be diluted in the older or larger bull calves, so sexual development is not affected. Future research may be warranted to determine whether larger doses of Zeranol would reduce testicular growth and behavior as well as to increase gain, carcass grade and composition.

Animal Behavior: McKenzie (1984) found that implanting young bulls with Zeranol early in life (less than 6 mo of age) reduced aggressive behavior. In contrast, implanting yearling bulls once or twice did not reduce aggressive behavior (Gregory and Ford, 1983). Price and Makarechian (1982) found Zeranol implanted bulls after 6 mo to be more docile when compared to control bulls. In the present study, the control bulls were found to be significantly different from implanted bulls ($P<.05$) in attempts to breed, in the number of actual services as well as in total mounts and services. For all other traits observed, differences were not observed.

Carcass Characteristics: Field (1971) reviewed fifteen studies and reported average dressing percentages for bullocks versus steers of 59.7% and 59.6% respectively. Allen (1982) summarized a composite of research trials and reported that bulls produce heavier carcasses. The carcasses of bulls in the present study were significantly ($P<.05$) leaner than their contemporary steer carcasses as observed from loin eye area, fat thickness, percent KPH fat and USDA yield grade. When comparing implanted and non-implanted bulls the control bull carcasses were slightly leaner for the above traits, followed by the implanted bull carcasses, implanted steers and control steers. Cooper and Kirk (1983) reported Friesian bulls implanted from near birth to slaughter had greater lean meat yields and larger ribeye areas, thus heavier longissimus weights. In the present study, implanted bulls had more subcutaneous fat than the control bulls. This agrees with Greathouse *et al.*, 1983 and McKenzie (1983), who showed that Zeranol implants increase fat deposition in bulls. Carcass cutout data in the present study confirm work done by Bailey *et al.*, 1985. Fortin *et al.*, 1985 reported bulls had a smaller percentage of round when compared to steers.

These data confirm that castration and implants have significant effects on behavior, growth and carcass characteristics of young male bovines.

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