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Effect of Weight at Castration on Steer Performance in the Feedlot

M. A. Worrell
Clemson University

D. C. Clanton
don_clanton@comcast.net

Chris R. Calkins
University of Nebraska-Lincoln, ccalkins1@unl.edu

EFFECT OF WEIGHT AT CASTRATION ON STEER PERFORMANCE IN THE FEEDLOT[1]

M. A. Worrell[2], D. C. Clanton and C. R. Calkins[3]

University of Nebraska[4]
North Platte 69101

ABSTRACT

One hundred eighty-eight male calves were randomly assigned to one of five treatments at about 6 wk of age to determine the effect of castration at different weights on feedlot performance and carcass characteristics. Calves were castrated at 70, 230, 320 or 410 kg or left intact. All calves received a 36-mg zeranol implant 60 d postweaning and were re-implanted every 56 d for the duration of the trial (196 d). Animals were slaughtered between 14 and 15 mo of age. Intact males gained faster ($P<.05$) and were more efficient ($P<.05$) in converting feed to gain than the castrated males. There were no differences ($P>.10$) in average daily gain (ADG) or feed efficiency (F/G) for males castrated at 70, 230 or 410 kg. However, castration at 320 kg depressed ($P<.05$) ADG compared with males castrated at 70 kg. Castration at 70 or 230 kg resulted in higher ($P<.05$) marbling scores than castrating at heavier weights or not castrating. Intact males had the lowest marbling scores, although not significantly lower than castrating at 320 or 410 kg. Intact males had lower ($P<.05$) yield grade scores than males castrated at 70 or 230 kg but their yield scores were not different ($P>.10$) from those castrated at 320 or 410 kg. Tenderness of steaks from animals castrated at 70 kg was greater ($P<.10$) than for intact males or 410-kg castrates. Tenderness scores for animals castrated at 230, 320 or 410 kg were not different ($P>.10$) from the intact males.
(Key Words: Castration, Bulls, Steers, Feedlots, Performance, Carcasses.)

Introduction

Considerable interest has developed in growing and finishing young intact males to take advantage of their superior rate and efficiency of gain as compared with the castrated male (Arthaud et al., 1969, 1977; Jacobs et al., 1977a,b; Seideman et al., 1982; Gregory and Ford, 1983). In addition, carcasses from intact males are leaner and have a higher percentage of edible product (Arthaud et al., 1969, 1977; Field, 1971; Ntunde et al., 1977; Gregory and Ford, 1983). However, carcasses from intact males have repeatedly been inferior in quality grade and palatability traits to those from castrated males (Nichols et al., 1964; Bailey et al., 1966; Arthaud et al., 1969, 1977; Jacobs et al., 1977a,b; Landon et al., 1978; Gregory et al., 1983).

Gregory and Ford (1983) suggested that the majority of the advantage in rate and efficiency of gain of intact males may be expressed by 1 yr of age. Therefore, delaying castration may be an approach for increasing performance in the feedlot without reducing the carcass characteristics of slaughter animals (Ford and Gregory, 1983; Gregory et al., 1983). Comparisons of feedlot performance and carcass characteristics between early and late castrates and with intact males have not been reported in the literature, thus, this study was initiated to make those comparisons.

Experimental Procedures

One hundred eighty-eight male calves (3/8 Angus, 3/8 Hereford, 1/8 Gelbvieh, 1/8 Simmental) were randomly assigned to one of five treatments at about 6 wk of age. There were two pens for each treatment blocked over two age groups. One group of calves was born in March and weaned the middle of September; the other group was born in April and weaned the middle of October. There were 9 to 10

[1] Journal paper no. 8030, Univ. of Nebraska Agr. Res. Division.
[2] Present address: Edisto Res. and Educ. Center, Clemson Univ., Blackville, SC 29817.
[3] Dept. of Anim. Sci., Univ. of Nebraska, Lincoln 68583.
[4] West Central Res. and Ext. Center.
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calves in each pen within treatment within age group. The first age group was started on experiment 1 mo before the second; likewise, the experiment was terminated for the first age group 1 mo earlier than the second. Calves were surgically castrated at 70, 230, 320 or 410 kg, or left as intact males.

Sixty days postweaning (220 kg weight) the calves were placed on a growing-finishing program for 196 d. During the growing phase (84 d) the calves received a silage-based ration followed by a step-up program to a high-concentrate ration for the remaining 112 d of the trial (table 1).

Calves in all five treatments were implanted with 36 mg zeranol at the beginning of the growing phase and were re-implanted every 56 d for a total of four implants per animal. Surgical castration was imposed when average weight of the calves in each treatment group reached pre-planned weights. Stress of castration lasted about 1 wk; there were no death losses. All animals were slaughtered between 14 and 15 mo of age.

Hot carcass weights were recorded at slaughter. Outside fat cover, internal fat, ribeye area, quality and yield grades were recorded in the packing house cooler after a 48-h chill. Wholesale ribs from 10 animals in each treatment from the second age group were removed and shipped to the University of Nebraska, Loeffel Meat Laboratory for evaluation. Ether extractable lipids, crude protein and moisture were determined on the ribeye (Longissimus dorsi) muscle trimmed of exterior fat and connective tissue. Steaks were thawed 24 h at 2 C and oven-roasted to 35 C in a rotary hearth oven set at 177 C, turned and removed when internal temperature reached 70 C. They were evaluated by an eight-member trained (Cross et al., 1978) taste panel for muscle fiber tenderness, juiciness, connective tissue amount and overall tenderness. An eight-point rating system (1 = extremely tough muscle fibers, extremely dry, abundant connective tissue, extremely tough overall; 8 = extremely tender muscle fibers, extremely juicy, no connective tissue, extremely tender overall, respectively) was used. Warner-Bratzler shear force was determined on 1.3-cm cores from the steaks.

Data were analyzed using the Statistical Analysis System (SAS, 1982). Analysis of variance for the feedlot performance and carcass characteristics was conducted using a model that contained effects for age, castration treatment, age × castration treatment and pens within age × castration treatment as the sources of variation. Analysis of variance for the rib section chemical analyses and taste panel evaluation was conducted using a model that contained effects for castration treatment and pen within castration treatment as the sources of variation. Differences among the least-squares treatment means were tested using Bonferroni t-tests.

Results and Discussion

Performance. Average daily gain (ADG) during the growing phase was not different ($P>.05$) among the castration treatments of 70, 320 or 410 kg and the intact males (table 2). Animals castrated at 230 kg (the beginning of the growing phase) gained less than those castrated at 410 kg and the intact males ($P<.05$) and males castrated at 70 kg ($P<.10$). Males castrated at 230 kg tended to be less efficient than those on the other treatments; however, there were no differences ($P>.10$) in efficiency among treatments during the growing phase.

Castration at 320 kg (the end of the growing phase) resulted in slower gains ($P<.05$) during the finishing phase than castration at 70 or 230 kg or noncastration. No difference was detected in average daily gain between castration at 320 or 410 kg. Intact males gained faster ($P<.05$) than all other groups. There were no differences ($P>.10$) in gains between castration at 410 kg and castration at 70 kg or 230 kg. Feed efficiency during the finishing phase followed a

TABLE 1. DIET COMPOSITION AND ANALYSIS

Item	Growing	Finishing
Ingredient[a]		
Corn	40	80
Corn silage	40	12
Alfalfa	12	
40% protein supplement	8	
32% protein supplement		8
Analysis[b]		
NE_m, Mcal/kg[c]	1.82	2.12
NE_g, Mcal/kg[c]	1.20	1.45
Crude protein, %	12.30	11.50

[a]Percent of dry matter.

[b]Dry matter basis.

[c]Calculated values.

TABLE 2. EFFECT OF WEIGHT AT CASTRATION ON PERFORMANCE IN FEEDLOT

Trait	Weight at castration, kg				Intact males	SD[a]
	70	230	320	410		
Beginning wt, kg	221	222	227	223	222	28.77
Final wt, kg[b]	487[cd]	484[c]	468[c]	482[c]	513[d]	40.10
Daily gain, kg						
Growing (84 d)	1.24[cd]	1.18[d]	1.20[cd]	1.26[c]	1.26[c]	.16
Finishing[b] (112 d)	1.34[c]	1.34[c]	1.17[d]	1.26[cd]	1.54[e]	.18
Combined[b] (196 d)	1.30[c]	1.28[cd]	1.18[d]	1.26[cd]	1.42[e]	.13
SE coefficient X 100[a]	18.40	51.69	20.52	27.75	16.59	
Feed efficiency						
Growing (84 d)	5.80	6.16	5.94	5.75	5.65	.34
Finishing[b] (112 d)	5.92	6.00	6.56	6.36	5.74	.48
Combined[b] (196 d)	6.05[c]	5.88[cd]	6.71[c]	6.35[c]	4.92[d]	.42
SE coefficient X 100[a]	50.00	50.00	50.00	50.00	50.00	

[a]Standard error (SE) of a least-squares mean can be determined by multiplying the SE coefficient by the standard deviation (SD) of a trait; e.g., SE of final wt for intact males = .1659 X 40.10 = 6.65.

[b]Adjusted to 62% dressing percentage.

[c,d,e]Means in the same row without a common superscript differ (P<.05).

similar pattern to gains, although differences among the treatments were not signficant (P>.10).

Combining the growing and finishing phases, animals castrated at 320 kg had lower (P<.05) gains than either males castrated at 70 kg or those left intact. No differences (P>.10) in gains were observed among those castrated at 70, 230 or 410 kg. Intact males gained faster (P<.05) for the entire feeding period than any of the castrated groups. Overall feed efficiency followed a similar pattern, i.e., intact males were more efficient (P<.05) than males castrated at 70, 320 or 410 kg and males castrated at 230 kg (P<.10). Animals castrated at 320 or 410 kg tended to be less efficient than the other castrate groups; however, feed to gain was similar (P>.10) for all castration treatments.

Carcass Characteristics. Intact males had heavier (P<.05) carcasses than the males castrated at 230, 320 or 410 kg. While intact males appeared to have heavier carcasses than those castrated at 70 kg, the difference was not significant. Those castrated at 320 kg produced

TABLE 3. EFFECT OF WEIGHT AT CASTRATION ON CARCASS CHARACTERISTICS

Trait	Weight at castration, kg				Intact males	SD[a]
	70	230	320	410		
Carcass wt, kg	302[cd]	300[c]	290[c]	299[c]	318[d]	24.88
Marbling score[b]	5.0[c]	5.4[c]	4.2[d]	4.0[d]	3.5[d]	1.15
Yield grade	2.7[c]	3.0[c]	2.6[cd]	2.5[cd]	2.3[d]	.52
Ribeye area, cm^2	77.1[c]	69.7[c]	74.8[c]	79.0[c]	84.2[d]	7.10
Fat covering, cm	1.15[c]	1.31[cd]	1.10[cd]	1.05[cd]	.97[d]	.33
Kidney, pelvic, heart fat %	2.1[e]	1.9[ef]	1.8[ef]	1.9[ef]	1.8[f]	.41
SE coefficient X 100[a]	18.40	51.82	20.48	27.85	17.00	

[a]Standard error (SE) of a least-squares mean can be determined by multiplying the SE coefficient by the standard deviation (SD) of a trait; e.g., SE of carcass wt for intact males = .1700 X 24.88 = 4.23.

[b]Marbling score: 3 – 3.9 = traces, 4 – 4.9 = slight, 5 – 5.9 = small.

[c,d]Means in the same row without a common superscript differ (P<.05).

[e,f]Means in the same row without a common superscript differ (P<.10).

TABLE 4. EFFECT OF WEIGHT AT CASTRATION ON CHEMICAL ANALYSES FROM RIB SECTIONS

Trait	Weight at castration, kg				Intact males	SD[a]
	70	230	320	410		
Ether extractable lipids, %[b]	5.08	5.44	5.56	3.62	4.08	1.59
Crude protein, %[b]	24.84	24.10	23.69	24.36	23.12	1.26
Moisture, %	70.68	71.02	70.63	72.33	72.11	1.42
SE coefficient X 100[a]	34.00	40.90	42.72	32.33	32.18	

[a]Standard error (SE) of a least-squares mean can be determined by multiplying the SE coefficient by the standard deviation (SD) of a trait; e.g., SE of crude protein for intact males = .3218 X 1.26 = .4055.

[b]Dry matter basis.

lighter carcasses than any of the other treatment groups; however, they were different ($P<.05$) only from the intact males (table 3).

Castration at weights of 230 kg or less resulted in higher marbling scores ($P<.05$) than castrating at heavier weights or not castrating. There were no differences ($P>.05$) in marbling scores among the castration treatments of 320 and 410 kg and the intact males. Intact males had lower ($P<.05$) yield grade scores than males castrated at 70 or 230 kg, but, were similar ($P>.05$) compared with males castrated at 320 or 410 kg.

Intact males and males castrated at 410 kg tended to have lower ($P>.10$) ether-extractable lipids in the ribeye than males castrated at 70, 230 or 320 kg, indicating a lower fat content in the lean (table 4). Moisture content in the ribeye paralleled in reverse the lipids content. The somewhat higher moisture and lower ether-extractable lipids of the 410-kg castrates and intact males appears to agree with carcass marbling score, fat covering, and kidney, pelvic and heart fat measurements (table 3). There were no differences in crude protein among the treatments.

No differences ($P>.10$) were evident in juiciness of steaks from castrated animals or intact males (table 5). Overall tenderness of steaks from males castrated at 70 kg was greater ($P<.10$) than for males castrated at 410 kg or the intact males. Tenderness scores for animals castrated at 230 or 320 kg were intermediate between males castrated at 70 kg and males

TABLE 5. EFFECT OF WEIGHT AT CASTRATION ON TASTE PANEL EVALUATION AND SHEAR FORCE ANALYSIS OF STEAKS FROM RIB SECTIONS

Trait	Weight at castration, kg				Intact males	SD[a]
	70	230	320	410		
Juiciness[b]	4.8	5.0	5.3	5.1	5.0	1.2
Muscle fiber tenderness[b]	6.4[c]	6.0[cd]	6.3[cd]	5.9[d]	5.8[d]	1.1
Connective tissue amount[b]	7.2[c]	6.6[cd]	6.3[d]	6.5[cd]	6.5[cd]	1.4
Overall tenderness[b]	6.4[c]	6.0[cd]	6.3[cd]	5.9[d]	5.9[d]	1.1
SE coefficient X 100[a]	15.29	14.78	13.78	14.97	12.24	
Warner-Bratzler	3.1	3.0	3.1	3.2	3.1	.4
SE coefficient X 100[a]	34.90	39.66	41.64	32.42	32.28	

[a]Standard error (SE) of a least-squares mean can be determined by multiplying the SE coefficient by the standard deviation (SD) of a trait; e.g., SE of juiciness for intact males = .1224 X 1.2 = .1469.

[b]Eight-point rating scale: 1 = extremely tough muscle fibers, extremely dry, abundant connective tissue, extremely tough overall; 8 = extremely tender muscle fibers, extremely juicy, no connective tissue, extremely tender overall, respectively.

[c,d]Means in the same row without a common superscript differ ($P<.10$).

castrated at 410 kg or intact males. However, treatment groups were not different (P>.10) for Warner-Bratzler shear values.

The data from this study indicate that castration of male calves should be performed at or before 230 kg to achieve higher carcass qualities, or males should be left intact to obtain increased feedlot performance, efficiency and carcass leanness. It may be possible to improve carcass quality of late castrates or intact males by increasing time on feed; however, longer feeding periods for intact males may reduce feed efficiency and gains to levels that are similar to levels of early castrates.

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