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D. U. Thomson
*Kansas State University, Manhattan*, dthomson@vet.k-state.edu

M. E. Youngers
*Oklahoma State University*, mesteph@okstate.edu

E. F. Schwandt
*Kansas State University, Manhattan*, eschwandt@k-state.edu

*See next page for additional authors*



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# Bulls Are More Efficient Than Steers with Similar Meat Quality

*D.U. Thomson, M.E. Youngers[1], E.F. Schwandt, S.J. Bartle, M. Siemens[2], J.C. Simroth, and C.D. Reinhardt*

## Introduction

Bull breeding soundness evaluations are often performed as a critical component of beef cow herd management to ensure that herd bulls have adequate semen quality, are physically capable of enduring the breeding season, and to determine the serving capacity per bull. Currently, there are approximately 30.3 million beef cows and 2.1 million bulls in the U.S. Depending on the breeding soundness evaluation failure rate, there are likely several hundred thousand bulls which will enter the beef market annually and a portion will be young bulls with the potential to be fed and sold to produce saleable meat of choice or select quality grade.

Castration of male cattle is a common procedure that is practiced world-wide, but is more common in the U.S. than in many countries. Behavioral benefits from castration include reduced aggressiveness and sexual activity by reducing testosterone levels. In addition, castrated animals maintain a lower muscle pH post-harvest producing fewer "dark cutters." Bulls have greater feeding performance and efficiency than steers. However, a bull's ability to gain efficiently and produce a leaner carcass, with more value to the packer and retailer, is overshadowed by the perception that meat from bulls is less tender than meat from steers.

Castration methods and the age at castration influence the potential stress on the animal, resulting in concerns regarding animal welfare and animal performance; therefore, castration of post-pubertal bulls to improve meat quality should be re-evaluated. The objective of this study was to evaluate the effects of castration and the use of growth promotion technologies in post-pubertal bulls on feeding performance, carcass traits, and meat quality characteristics compared to intact post-pubertal bulls.

Key words: bulls, carcass, meat quality

## Experimental Procedures

The study was conducted at Kansas State University from June through August of 2014. Purebred Red Angus and Black Angus bulls (n = 30; initial body weight =

[1] Department of Animal Science, Oklahoma State University, Stillwater, OK.
[2] Cargill Meat Solutions, Wichita, KS.

1,336 ± 25.1 lb; average age = 16 months) were used in a randomized complete block design to evaluate the effects of castration of post-pubertal bulls on feeding performance, carcass traits, and meat quality characteristics.

Bulls were individually weighed and vaccinated with Pyramid 5 (Vetmedica, St. Joseph, MO) and Cavalry 9 (Merck Animal Health, Madison, NJ) and received Cydectin pour-on (Vetmedica, St. Joseph, MO). Twenty-four of the 30 purebred bulls were selected based on body weight uniformity. Bulls were blocked by breed, stratified by weight, and randomly assigned to treatment and pen, so that breed distribution was similar among pens. Treatments included: intact (n = 12) or castrated with addition of growth-promoting technologies (n =12). There were 4 animals per pen. Cattle were fed in a Calan Gate individual animal feeding system in 6 outdoor dirt-floor pens approximately 20 × 4 ft. Cattle were acclimated to the pens and Calan Gate feeders for 26 days prior to trial initiation.

On study day 0 all cattle were weighed prior to feeding. Animals assigned to the castrated treatment were subsequently castrated using a Callicrate bander (St. Francis, KS) and implanted with 120 mg of trenbolone acetate and 24 mg of estradiol implant. The last 28 days of feeding, the castrated cattle were fed 1 lb/day of a pellet containing 300 mg/lb ractopamine hydrochloride beta-adrenergic agonist to provide 300 mg/head/day of ractopamine hydrochloride. Cattle in the intact treatment were not implanted and were fed a similar amount of a placebo pellet the last 28 days on feed. The placebo and beta-adrenergic agonist pellet consisted of corn, alfalfa meal, and liquid molasses.

Cattle were fed a dry-rolled corn-based total mixed finishing diet for 62 days (Table 1). Diet samples were taken from each individual bunk and mixed together into one complete sample and submitted on a monthly basis to evaluate nutrient composition. Feed was delivered daily by 8:00 a.m., with residuals collected and weighed prior to feed delivery. On day 35, the beta-adrenergic agonist or placebo pellet was introduced and fed for the remaining 28 days. On day 63, cattle were transported approximately 1,000 miles to a commercial abattoir. During the 3 hour lairage, animals from the same treatment were penned together to avoid any potential pre-harvest stress due to mixing of bulls and steers.

Thirty-six hours post-mortem longissimus muscle samples 2 in. thick were taken from the left and right side of each carcass at the 12th rib for Warner-Bratzler shear force and sensory panel evaluation. Trained personnel evaluated carcasses and provided data for quality and yield grades using the United States Standards for Grades of Carcass Beef, longissimus muscle area using video image analysis camera, back-fat thickness, and marbling scores. Longissimus samples were aged in the vacuum sealed packaged for 14 days postmortem at 39°F.

Data were analyzed using the GLIMMIX procedures of SAS with treatment included as a fixed effect and breed included as a random effect; initial body weight was used as a covariate. Means were generated with the LSMEANS statement and separated using the DIFF function when the F-statistic was significant ($P<0.05$).

## Results and Discussion

Cattle in the intact treatment had greater average daily gain and gain:feed (P=0.02; Table 2) compared to cattle in the castrated treatment. There was no difference in dry matter intake between treatments (P=0.90).

No differences (P>0.05) were observed between treatments for hot carcass weight, yield grade, quality grade, marbling score, dressing percent, or back-fat thickness (Table 3). Cattle in the intact treatment had greater longissimus muscle area than cattle in the castrated group (P<0.05).

Animals in the intact treatment tended (P≤0.10) to have greater Warner Bratzler shear force and less desirable overall tenderness, but there were no differences in any other sensory assessments (Table 4).

## Implications

Results from this study suggest that carcass traits, growth parameters, and meat quality characteristics were not improved by castrating post-pubertal bulls. These results strongly suggest that intact bulls should remain intact to eliminate animal welfare concerns arising from castration and castration-induced stress, leading to poorer performance when meat quality is similar between post-pubertal bulls and steers.

**Table 1. Ingredient composition of study diet to evaluate the effects of castration on post-pubertal male cattle on growth, feed efficiency, and meat quality characteristics**

| Ingredient[1] | % of dry matter |
|---|---|
| Dry-rolled corn | 58.5 |
| Dried distillers grains plus solubles | 21.5 |
| Cottonseed hulls | 12.3 |
| Molasses, cane | 2.5 |
| Supplement pellet[2] | 5.2 |
| Chemical composition, dry matter basis | |
| Dry matter, % | 86.6 |
| Crude protein, % | 13.8 |
| Calcium, % | 0.90 |
| Phosphorus, % | 0.45 |

[1]Diet fed without ractopamine hydrochloride from days 1-62.

[2]Contained ground corn (90.0%), alfalfa meal (6.0%), and E-Z Glo molasses (4.0%); castrated treatment pellet contained 300 mg/lb ractopamine hydrochloride added to the feed bunk at 1.0 lb per animal daily; intact treatment pellet contained the same ingredients with no ractopamine hydrochloride.

**Table 2. Least squares means illustrating the effects of castration on growth, feed efficiency, and dry matter intake in 16 month old post-pubertal bovine males**

| | Treatment[2] | | | |
|---|---|---|---|---|
| Item[1] | Intact | Castrated | Probability>F | SEM[3] |
| Initial weight, lb | 1324 | 1340 | 0.65 | 3.5 |
| Final weight, lb | 1551 | 1516 | 0.30 | 55.7 |
| Average daily gain, lb | 4.07 | 3.19 | 0.02 | 0.46 |
| Dry matter intake, lb | 34.76 | 34.98 | 0.90 | 2.29 |
| Gain:feed | 0.12 | 0.09 | 0.02 | 0.012 |

[1]Least squares treatment mean.
[2]Intact post-pubertal male bovine or castrated via banding of post-pubertal male bovine.
[3]Standard error of the least squares mean.

**Table 3. Least squares means illustrating the effects of castration on carcass characteristics in post-pubertal bovine males**

| | Treatment[2] | | | |
|---|---|---|---|---|
| Item[1] | Intact | Castrated | Probability>F | SEM[3] |
| Hot carcass weight, lb | 981 | 955 | 0.36 | 19.3 |
| Dressing percentage | 63.74 | 63.73 | 0.99 | 0.7 |
| Longissimus muscle area, in.$^2$ | 16.6 | 15.0 | < 0.01 | 0.57 |
| 12th rib fat depth, in. | 0.41 | 0.40 | 0.85 | 0.04 |
| Yield grade[4] | 2.73 | 3.08 | 0.15 | |
| Quality grade[5] | Low Choice | Low Choice | 0.34 | |
| Marbling score[6] | 502 | 502 | 0.98 | |

[1]Least squares treatment mean.
[2]Intact post-pubertal male bovine or castrated via banding of post-pubertal male bovine.
[3]Standard error of the least squares mean.
[4]USDA yield grade calculated from carcass measurements.
[5]Quality grade reported as USDA Low Choice.
[6]Marbling score units: 400 = Small$^{00}$, 500 = Modest$^{00}$.

**Table 4. Least squares means illustrating the effects of castration on post-pubertal bovine males on Warner-Bratzler shear force and sensory panel analysis of longissimus steaks**

| | Treatment[2] | | | |
|---|---|---|---|---|
| Item[1] | Intact | Castrated | Probability>F | SEM[3] |
| Juiciness[4] | 5.22 | 5.03 | 0.29 | 0.13 |
| Overall tenderness[5] | 5.26 | 5.53 | 0.07 | 0.10 |
| Beef flavor intensity[6] | 5.27 | 5.24 | 0.86 | 0.21 |
| Connective tissue amount[7] | 5.93 | 6.22 | 0.15 | 0.41 |
| Myofibrillar tenderness[8] | 5.23 | 5.42 | 0.45 | 0.18 |
| Off flavor intensity[9] | 7.66 | 7.63 | 0.81 | 0.22 |
| Warner-Bratzler shear force, lb/0.5 in.[2] | 10.56 | 9.46 | 0.10 | 0.46 |

[1]Least squares treatment mean.
[2]Intact post-pubertal male bovine or castrated via banding of post-pubertal male bovine.
[3]Standard error of the least squares mean.
[4]8 = Extremely juicy, 7 = very juicy, 6 = moderately juicy, 5 = slightly juicy, 4 = slightly dry, 3 = moderately dry, 2 = very dry, 1 = extremely dry.
[5]8 = Extremely tender, 7 = very tender, 6 = moderately tender, 5 = slightly tender, 4 = slightly tough, 3 = moderately tough, 2 = very tough, 1 = extremely tough.
[6]8 = Extremely intense, 7 = very intense, 6 = moderately intense, 5 = slightly intense, 4 = slightly bland, 3 = moderately bland, 2 = very bland, 1 = extremely bland.
[7]8 = None, 7 = practically none, 6 = traces, 5 = slight, 4 = moderate, 3 = slightly abundant, 2 = moderately abundant, 1 = abundant.
[8]8 = Extremely tender, 7 = very tender, 6 = moderately tender, 5 = slightly tender, 4 = slightly tough, 3 = moderately tough, 2 = very tough, 1 = extremely tough.
[9]8 = None, 7 = practically none, 6 = traces, 5 = slight, 4 = moderate, 3 = slightly abundant, 2 = moderately abundant, 1 = abundant.