Cull Cow Meat Quality

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Introduction

Cows are culled for many reasons however; the most common reason is due to failure to conceive upon exposure during the breeding season. Most of the cows in Florida are culled in the mid to late fall and sold either at the auction or direct to a cull cow packer. Due to increasing beef demand and short supply chains there is a need in the beef industry to fill voids of middle and intermediate value cuts. It is fairly common to hold and feed cull cows for a period of time, if feed reserves are plentiful and cattle prices are low, in order to sell the cows when prices increase in the late winter or early spring. Supplemental feeding of cull cows may produce enough acceptable beef to fill supply voids.

Florida's cow population currently ranks 12th in the country and third east of the Mississippi river with an estimated 1.1 million head of cows (950,000 beef, and 150,000 dairy). With cull cow and replacement levels ranging from 10 to 35% annually, the sale of cull cows may account for 15 to 20% of ranch revenues (Sawyer et al., 2004). As well, approximately 5.1 million head of cull cows were sent to slaughter in 2004 accounting for almost 13% of the domestic beef supply (USDA, 2005). Cull cows which are typically thought of as a by-product of the beef industry are actually economically very important to both producers and processors. If supplemental feeding of cull cows can increase the economic returns of these animals, it could have a substantial impact on production bottom lines. Benchmarking carcasses and muscles from non-fed and fed cull cows is a way to determine if there is unrealized value that can be identified to meet current market demands for intermediately valued beef cuts.

Cull Cow Quality Problems

Beef quality is typically used in the industry to describe the perceived cooked meat palatability from a carcass. Beef quality is determined primarily by measurements of intramuscular fat (marbling), overall maturity (combination of lean and skeletal), and to a lesser extent lean firmness, lean texture, and lean color. The current quality grading system works very well with youthful (A and B maturity) carcasses. However, the current system does not accurately estimate the quality or palatability of meat from cull cow carcasses (Hilton et al., 1998). There are several carcass traits that need to be taken into account when examining cull cow carcasses that may have either a direct or indirect effect on the palatability and further utilization of the carcass. Some of the other traits to consider when examining cull cow quality include carcass weight, muscling (overall and 12th rib), and external fat color.

In 1994 the National Cattlemen's Association (NCA) conducted an industry overview of non-fed cattle at slaughter plants around the United States. One of the main focuses of the *National Non-Fed Beef Quality Audit* was to improve the consistency and competitiveness of non-fed beef and to improve the salvage value of cull cows. The purpose of this audit was to find areas the industry could improve upon within 10 years to increase the overall quality, value, and utilization of meat from cull cows.

During the 1994 NCA audit, cull cow carcass defects were outlined which included: 38.9% of cow carcasses were too light at less than 500 pounds, approximately 31% of cull cow carcasses had ribeye areas that were too small (less than 8.0 in^2), 67% of the carcasses had a muscling score of 2 or lower, and 41% of the cull cow carcasses had external fat deemed too yellow to be used as whole cuts or steaks even if the carcass muscling and quality were acceptable. In all, the 1994 quality audit found 15 defects totaling approximately $70.00 in unrealized value per head. The defects previously listed were grouped into three categories of light muscling, light carcass weight, and yellow fat which accounted approximately $20.00, or 30% of the total unrealized value per head. These

defects, which account for 1/5 of the problems and 1/3 of the unrealized value, could all possibly be corrected by management that included short term feeding prior to slaughter.

In 1999 the National Cattlemen's Beef Association (NCBA) conducted a second audit on cull cow quality. The purpose of the *National Market Cow and Bull Quality Audit* was to examine the progress made since the 1994 audit and to establish new benchmarks for cull cows to be reached by the year 2009. However, during the 1999 audit it was found that 43% of cow carcasses were still to light, 89% of cull cow carcasses were inadequately muscled, 31% of the carcasses had external fat that was too yellow, and approximately 84% of the carcasses had inferior marbling of Cutter/Canner classification or below. It was found that the 15 defects reported in the 1994 audit were still causing $69.00 per head of unrealized value. However, the three defects of light muscling, light weight, and yellow fat carcasses were now an estimated $26.50 of unrealized value or 38% of the total value loss not counting loss of use due to inferior marbling. Again, feeding these cull cows prior to slaughter would not fix all of the problems but could potentially increase the value of the cull cow to both the producer and processor.

Marketing and Processor Utilization

Currently, cull cows are not purchased based upon the same specifications that youthful cattle are. Many youthful fed cattle are purchased on a grid based system which pays for increased quality grade based upon scoring of marbling and overall maturity. However, cull cows are purchased based upon the estimated percent lean of the carcass and weight. Typically slaughter cow groups are divided into: 1) lean, which is 85 to 90% lean; 2) boners, which are 80 to 85% lean and; 3) breakers, which are 75 to 80% lean.

Either during purchasing or upon delivery of cull cows to the point of slaughter, cows will typically be divided into slaughter lots based upon live body condition score (BCS) (BCS, 1 = severely emaciated, 9 = severely obese) and the associated perception of carcass and muscle quality. Although the terminology used to describe cull cows and their carcasses varies widely among slaughter and processing plants, cows with a BCS of 1 to 3 are typically considered "boners" and are used for ground beef production, cull cows with a BCS of 4 to 6 are considered "boning utilities" and may be used for ground product or boneless subprimal fabrication if of high enough quality, while cull cows with a BCS of 6 to 8 are considered "breaking" cows and are thought to be of high enough quality to be fabricated into primal cuts for manufactured beef (Apple et al., 1999). In the 1999 NCBA audit, 41% of beef cows were reported as having a BCS of 4 or less which meant a large portion of the cow carcasses would not be utilized as primal or subprimal beef but would instead be put into lean trimmings based solely on BCS.

Because most cow slaughter plants segregate cattle at the point of slaughter based upon their condition and the perception of condition on quality, Apple et al. (1999) at the University of Arkansas, researched the effects of BCS on cull cow quality and profitability. It was found that cull cows in a BCS of 6 put together the optimal carcass package considering muscling and fat thickness, with 73% of the cull cows having a USDA quality grade of Utility or greater. Body condition score 6 cull cows were also the most profitable based upon total product yields from the carcass. As cull cows increased in BCS above 6 they did not increase in muscling or quality grade but did increase in fat cover which made them low in lean yields and cutability and therefore decrease profitability. Cull cows in BCS of 2 to 5 did not have the carcass weight or carcass quality to be utilized for boneless subprimal fabrication and would therefore most likely be used in ground products which are of lower value.

Effects of Feeding Cull Cows on Quality

It is reasonable to assume that feeding cull cows for a short period of time prior to slaughter could improve some of the quality defects found during the NCBA quality audits, and could also increase BCS of cull cows to an acceptable level. As well, it was hypothesized that concentrate feeding of cull cows would improve carcass and muscle quality, therefore

making cull cow meat a more acceptable source for an intermediately priced yet palatable beef option to meet increasing demands.

Twenty-four cull cows were randomly selected from two cow herds at the University of Florida Beef Research Unit (Gainesville, FL) and Boston Farm – Santa Fe River Ranch (Alachua, FL). Cows were culled for failure to conceive upon exposure to artificial insemination or natural service. Cows were stratified to one of three groups to be fed a concentrate diet for 0, 42, or 84 days prior to slaughter. There was no difference in live weight, BCS or age among the three treatment groups at the start of the feeding period (Table 1). Cull cows were fed on ground bunk feeders at a limit of 25 lb/day of a whole corn based diet that was 12% crude protein and 75% total digestible nutrients. No roughage was provided other than the 7.5% cottonseed hulls in the ration formulation. Live weights and BCS were taken at the beginning, after 42 days, and after 84 days. At the end of the respective feeding periods cull cows were slaughtered at the University of Florida Meats Processing Center. Carcass characteristics were measured and nine muscles were collected for shear force analysis and four muscles were collected for sensory panel evaluation from the chuck, loin, and round.

Cull cow live and carcass characteristics are presented in Table 2. Cull cows that were fed a concentrate diet for 84 days had heavier live weights, increased average daily gains, and increased BCS when compared to cull cows that were fed for 0 or 42 days. The cull cows fed for 84 days achieved a BCS of 6.0 which is optimal for increasing quality, utilization, and value. As well, cull cows that were fed for 84 days had increased hot carcass weights, ribeye areas, and increased 12th rib fat thickness which led to an increased preliminary yield grade (PYG). However, all three cull cow groups had PYG that would be considered yield grade 2 or borderline yield grade 2/3. Cull cows that were fed for 84 days had a lower percent lean than did cull cows that were not fed. Cull cows that were not fed fell into the "lean" category of 85 to 90% while cull cows that were fed for 84 days would have fallen into the "boning" category at 80 to 85% lean. This coupled with the increased weight and the high dressing percent of almost 55% could make cull cows fed for 84 days more valuable than cull cows that were not fed or fed for a shorter period of time.

When examining factors that directly determine carcass quality, feeding cull cows for 84 days had a significant impact on the perception of the lean maturity. Lean from cull cows fed for 84 days was more youthful, firmer, slightly finer-textured, and brighter red-colored than the lean from cull cows that were not fed or fed for 42 days. As well, cull cows that were fed for 84 days exhibited more marbling than cull cows that were not fed. When all of these factors are added together the cull cows that were not fed would fall on the Canner/Utility line while cull cows that were fed for 42 days were average Utility and cull cows that were fed for 84 days were classified as high Utility. External carcass fat of cull cows fed for 84 days was significantly whiter than the carcass fat of cull cows that were not fed or fed for 42 days.

Since quality is used as a predictor of cooked meat palatability, it is helpful to include sensory panel evaluations in studies that may alter the meat quality (Table 3). In the current study it was found that mechanical measures of tenderness (Warner-Bratzler shear force) were not different between the three feeding groups when all nine muscles were pooled together. The loin muscle did become significantly more tender as days on feed increased, and all but one muscle were more tender or similar to the loin after cull cows were on feed for 84 days. However, sensory panelists were able to detect differences in tenderness among the three groups with steaks from the cull cows fed for 84 days being the most tender overall. There were no differences detected among groups for sensory juiciness or beef flavor intensity. There were however differences in detectable off-flavor, which is a large component of meat palatability. Steaks from cull cows that were fed for 42 or 84 days had significantly less detectable off-flavors than steaks from cull cows that were not fed. Off-flavor detection was also reduced from 50% of the samples having off-flavors when cull cows were not fed to 33 and 32% of samples having off-flavors when cull cows were fed for 42 or 84 days respectively.

Conclusions

As long as the cow is a healthy and productive member of the herd she will most likely not be culled. Short-term supplemental feeding improved lean maturity and marbling in this study, increasing the utility of lean produced from these animals. As well, supplemental feeding increased body condition score, live weight, hot carcass weight, ribeye area, dressing percentage, and muscling along with improvements in fat color (whiter) and a more tender and palatable product. Considering these improvements together with shifting the marketing and sale of the cull cows from the low price point of mid fall to the higher price point of late winter/early spring, it may be profitable and beneficial to both producers and processors to consider short-term supplemental feedings of cull cows prior to slaughter.

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Table 1. Least squares means of live traits used to stratify cull cows into feeding groups.

	Days on feed			
Item	0 days	42 days	84 days	Std error
Age, yrs	5.25	5.50	5.63	0.47
Live wt, lbs	1019.3	1016.8	1010.2	42.33
BCS[1]	4.9	4.7	4.4	0.20

[1]Body condition score: 1 = Severe emaciation, 9 = Severe obesity.

Table 2. Least squares means for live performance and carcass characteristics.

	Days on feed			
Trait	0 days	42 days	84 days	Std error
Live				
Live wt, lbs	1057.8[b]	1078.0[b]	1250.9[a]	49.43
ADG[1], lbs	0.00[b]	0.81[b]	2.18[a]	0.35
BCS[2]	4.9[b]	5.4[b]	6.0[a]	0.17
Carcass				
Hot carcass wt, lbs	504.5[b]	575.5[b]	684.4[a]	27.74
Dressing percent	47.7[b]	53.4[a]	54.8[a]	1.15
Ribeye area, sq. in.	9.98[b]	11.17[ab]	12.23[a]	0.45
Fat thickness, in	0.09[b]	0.16[b]	0.37[a]	0.04
PYG[3]	2.22[b]	2.48[b]	2.98[a]	0.12
Muscling[4]	388[b]	488[b]	650[a]	53.31
Percent lean[5]	86.4[a]	85.1[ab]	82.9[b]	0.94
Lean maturity[6]	D 63[a]	D 95[a]	C 60[b]	20.39
Bone maturity[6]	D 61	D 90	E 14	26.15
Lean color[7]	5.3[a]	4.9[ab]	4.1[b]	0.30
Fat color[8]	5.0[c]	3.9[b]	2.8[a]	0.29
Marbling[9]	255[b]	312[ab]	359[a]	23.93
Lean texture[10]	4.5	4.3	3.8	0.28
Lean firmness[10]	3.8[a]	2.6[ab]	2.4[a]	0.37

[abc]Means in the same row with different superscripts are different at P < 0.05.
[1]ADG = Average daily gain.
[2]Body condition score: 1 = Severely emaciated, 9 = Severely obese.
[3] PYG = Preliminary yield grade (USDA, 1995), used to express expected yield of boneless, closely trimmed retail cuts.
[4]100 = Light[-], 900 = Heavy[+].
[5]Calculations based on USDA, 2000.
[6]Lean and bone maturity (USDA, 1995) used to express physiological age for use in quality grading.
[7]1 = Extremely bright cherry red, 8 = Extremely dark red.
[8]1 = White, 5 = Yellow.
[9]100 = Practically devoid, 200 = Traces, 300 = Slight, 400 = Small.
[10]1 = Very fine, Very firm; 5 = Course, Soft.

Table 3. Warner-Bratzler shear force and sensory trait least squares means for the main effect of days on feed[1].

	Days on Feed			
Trait	0 days	42 days	84 days	Std error
WBS[2], lbs	11.8	11.9	11.3	0.37
Tenderness[3]	4.3[b]	4.5[b]	5.0[a]	0.13
Beef flavor[3]	5.3	5.3	5.5	0.07
Juiciness[3]	5.2	5.0	5.0	0.09
Off-flavor[4]	5.1[b]	5.5[a]	5.5[a]	0.05

[1]Values from all muscles were pooled together to examine the effect of days on feed.
[2]WBS = Warner-Bratzler shear force.
[3]1 = Extremely tough, bland, dry; 8 = Extremely tender, intense, juicy.
[4]1 = Extreme off-flavor, 6 = No off-flavor.
[ab]Means in the same row with different superscripts are different at P < 0.05.

Notes: