Project Summary

Effects of Feeding Regimen and Enhancement on Quality Characteristics of Muscles from Cull Cows

Principal Investigator: John Killefer, Ph.D.
University of Illinois

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Background

Cull or market cows represent an important source of beef for domestic and international markets. Meat from these animals is typically used for lower-value beef products (i.e. ground beef and lower quality whole muscle cuts). There are several muscles that historically have not been fabricated as whole-muscle cuts, but have the potential to be of greater value due to their desirable quality and sensory attributes.

Past research has examined methods to improve the quality of beef from market cows. Enhancement of certain cuts with brine solutions has the potential to further improve the sensory characteristics of underutilized muscles, thus adding value and improving the palatability of beef from market cows. Additionally, market cows that are supplemented with a high quality ration prior to harvest should have improved muscle yield, carcass composition and quality traits.

The objectives of this project were:

1. Determine the effects of feeding market cows a finishing ration as a means to improve carcass and meat characteristics.
2. Examine the effects of moisture enhancement on beef muscles from market cows that were supplemented prior to harvest versus those that were not.
3. Assess the effect of supplementing Optaflexx (Elanco Animal Health), a beta-agonist that acts as a repartitioning agent in the metabolism of proteins, to market cows that were provided a finishing ration and to evaluate any combined effects of enhancement on carcass and sensory attributes.

Methodology

Sixty non-dairy type market cows were obtained from local and regional sources in Illinois. Upon arrival at the University of Illinois Beef Research Unit, the cows were given a standard vaccination protocol, as well as an anthelmintic for parasites. Animals were assigned to pens based on body weight, hip height, body condition score and ultrasonic backfat thickness.

Dietary treatments consisted of a control group, fed group (high-concentrate ration) and a fed (high-concentrate ration) plus Optaflexx group. All of the cows were fed their respective treatment rations for 57 days prior to harvest, with the Optaflexx group receiving the supplement at 200mg per head per day for the last 35 days of the feeding period. Live weights were taken prior to harvest. One hour post harvest, *longissimus* pH measurements were recorded for all carcasses. Two animals were selected from each treatment group to monitor pH decline. Additional measurements for pH were taken at three, six and eight hours postmortem.

Muscle samples were removed from all carcasses at the tenth rib for proteolytic analysis. At 24 hours postmortem, the right and left sides of the carcasses were ribbed. Lean and skeletal maturity, marbling scores and percent kidney, pelvic and heart fat (KPH) values were recorded. Preliminary and adjusted yield grade (PYG and AYG, respectively) along with ribeye area (REA) were measured on the left side of each carcass.

Carcass fat color was measured subjectively and objectively. Subjective scores were evaluated by a six-member panel that evaluated the dorsal surface of the carcasses at the twelfth rib on the left side. Panelists used a six-point scale where one was white and six was dark yellow to orange in color. Objective scores were recorded using a chromameter and were taken from the left side of the carcass from the brisket, the dorsal surface of the twelfth rib and the tail head.

Carcasses were fabricated between 24 and 48 hours postmortem. The forequarter was split into the chuck and rib primals at the fifth and sixth rib, and the ribeye was removed for the aging portion of this study. The *serratus ventralis, complexus, psoas major, vastus lateralis, rectus femoris, longissimus dorsi, gracilis, pectineus, semimembranosus* and *adductor* muscles were removed, trimmed and weighed.

At two days postmortem, researchers fabricated two 2.5 cm steaks from each ribeye that were randomly assigned to one of four aging periods (two, seven, 14 and 21 days). Steaks within the same aging period were vacuum packaged together and stored at 4ºC (39.2ºF) until the appropriate aging time had been reached. Steaks were then frozen until shear force analyses could be conducted.

At 72 hours postmortem, all muscles from one side of each cow carcass were designated for enhancement. The enhancement formulation for muscles from the first harvest group was 0.3 percent salt and 0.3 percent phosphate. Each muscle was enhanced to 108 percent of its original weight. The researchers determined that some of the muscles had uptakes as high as 25 percent, so in subsequent harvest groups, the *rectus femoris, vastus lateralis, semimembranos*us and *adductor* were enhanced to 108 percent of their initial weight. The *complexus, serratus ventralis, psoas major, pectineus, gracilis* and the *longissimus dorsi* were enhanced to 114 percent of their initial weight.

At 13 days postmortem, muscles were evaluated for subjective and objective color values. Muscles were also evaluated for pH and non-enhanced steaks were subjected to a proximate analysis. Sensory panel evaluations were conducted for the *semimembranosus, psoas major* and *longissimus dorsi* for juiciness, tenderness, beef flavor and off-flavor. To help further characterize the effect of enhancement and any off-flavors associated with cow meat, the *adductor, rectus femoris, serratus ventralis,* and *vastus lateralis* were evaluated for tenderness, juiciness, beef flavor, saltiness, and off-flavor using a 15-point scale. Steaks used for shear force determination were weighed before and after cooking to calculate the percent cook loss.

Findings

Feeding market cows a finishing ration resulted in more internal fat (percent KPH) and external fat (adjusted fat thickness) at the twelfth rib than the cows on a strictly forage diet. Supplemental feeding also resulted in better yield grades and larger ribeye areas compared to control carcasses. Fat color was also improved by feeding the cows a finishing ration, based on subjective and objective color scores. Skeletal maturity was not affected by feeding treatment, however the cows fed Optaflexx as part of the finishing ration displayed more youthful lean color the cows fed the finishing ration without Optaflexx. Quality grade was improved in the carcasses from animals fed the high concentrate ration.

After two days of aging, steaks from the fed group had improved shear force values, but after seven, 14 and 21 days of aging, there was no difference in tenderness between treatment groups.

Initial weights for nine out of the 10 muscles were greater from animals fed the finishing ration. Supplementing the ration with Optaflexx had no effect on initial muscle weight. Proximate analyses were mixed in their results as fed cattle had more fat (higher marbling scores and more back fat) than the control group. For five out of the 10 muscles, there was a significant increase in the amount of percent lipid present in the muscle.

There were few differences in muscle color for the various treatments. Ultimate pH of the muscles was also not influenced by feeding the cattle a high concentrate ration.

Sensory analysis of the control group versus the animals that were fed a high concentrate ration did not result in any differences for juiciness, tenderness, beef flavor, saltiness or off-flavor. Due to limited muscle size, sensory analyses were only performed on the *adductor, serratus ventralis, vastus lateralis,* and *rectus femoris.*

Moisture enhancement generally increased the percent purge, especially for the *longissimus dorsi, semimembranosus, psoas major, serratus ventralis, gracilis* and *complexus*. All of the muscles that were enhanced were darker in color at 13 days postmortem according to panel evaluations. Enhancement increased the intensity of saltiness and the detectable level of off-flavor by the trained sensory panel. Enhancement did lower shear force values for all of the muscles except the *adductor.*

Implications

Throughout the live and carcass phase of this study, results indicated that supplementary feeding of cull cows resulted in animals that were able to put on more weight during the live phase, which translated into heavier carcasses. The high concentrate diet fed for 57 days helped increase marbling scores, and subsequently improved quality grade. The increase in muscle mass, improved quality grade, and whiter fat color could potentially increase the value of market animals.

In general, the feeding treatment resulted in more lean muscle mass in most of the cuts. Fed cattle also had increased lipid content in six of the 10 muscles. This result coincides with the higher marbling scores and increased fat thickness observed in the carcasses. There were only minimal changes in the color attributes, sensory characteristics or the shear force for the dietary treatments.

The greatest responses were seen when the enhanced product was compared to the non-enhanced product. Moisture enhanced product showed an improvement in juiciness and tenderness, and in conjunction with lower shear force values, resulted in a more palatable product. Enhanced muscles were darker in color, which could have some implications in product display.

The addition of Optaflexx resulted in some numeric improvements for traits such as hot carcass weight and dressing percentage, but there were few statistical differences between the cows fed the finishing ration and those that were also supplemented with Optaflexx. The researchers

attributed this to the high variability in the market cow population and the small numbers of animals used in this trial.

For more information contact:
National Cattlemen's Beef Association
9110 East Nichols Avenue
Centennial, Colorado 80112-3450
(303) 694-0305