

Project Summary

The Use of Citrate in Enhancement Solutions to Improve Quality of Muscles from the Forequarter in Fed and Non-Fed Cull Cows

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Project Summary

Background

Meat from cull cows represents an underutilized, and potentially undervalued, source of meat for domestic and international markets. Meat from these animals is typically used in the manufacture of lower value products, such as ground beef. Enhancement has seen extensive use in the beef industry to further improve palatability and consumer satisfaction. While the enhancement process has been successful in improving the quality of beef from younger animals, minimal research has been conducted with meat from cull cows.

Preliminary work with sodium citrate indicates that this substance could improve meat quality when it is used as a substitute to salt in a brine solution. When compared to a salt and phosphate solution, a sodium citrate and phosphate solution can increase pH, improve color, decrease shear values, and impart less saltiness.

The objectives of this project were to:

1. Characterize how cows that were selected as Fed or Nod-Fed, based on back-fat thickness, differed in quality for the selected muscles.
2. Assess the impact of replacing sodium chloride with sodium citrate in a brine solution, and determine what impact this has on the visual and meat quality characteristics of enhanced muscles from cull cows.

Methodology

At 24 hours postmortem, the left sides of 48 forequarters were selected from a commercial cow processing facility based on 12th rib back-fat thickness to represent both Fed and Non-Fed cows. An effort was made to select against dairy type cows. At 7 and 8 days postmortem, forequarters were fabricated to isolate the following muscles: *Longissimus*, *Complexus*, *Serratus ventralis*, *Teres major*, *Supraspinatus*, *Infraspinatus*, and *Triceps brachii*. Each muscle was trimmed, tagged, weighed and stored until further processing. Objective color scores and subjective scores for marbling and lean maturity were evaluated on *Longissimus* steaks.

Forequarters from the Fed and No-Fed groups were randomly assigned to Enhancement treatments. The day before enhancement, two 68 kg batches of brine were formulated for enhancement of product to 110% of green weight. The two enhancement treatments were: 0.3% Sodium Chloride and 0.3% Phosphate (Salt) or 0.5% Sodium Citrate (Citrate) in the final product. At 9 days postmortem, all muscles were enhanced with their pre-determined treatment. Muscles were weighed before and after treatment to determine percent uptake.

At 10 and 11 days post-enhancement, muscles were evaluated for percent purge, based on enhanced weight, and enhanced pH. Microbial counts were collected on *Longissimus* steaks. Initial and final microbial counts are reported as Log Colony Forming Units per square centimeter (Log CFU/cm²).

Steaks were cut from five muscles (*Supraspinatus*, *Infraspinatus*, *Triceps brachii* and *Longissimus*) for visual evaluation by a five-member panel and placed in a white, foam tray with permeable polyvinyl-chloride (PVC) overwrap. Initial day 0, day 2, and day 3 post-cut evaluations were made on each steak. Objective color scores were also recorded, and both subjective and objective color scores were measured on areas of the steak that exhibited minimal, or no, discoloration. Proximate analysis was also performed on *Longissimus* steaks.

Two groups of 5-6 trained panelists were utilized for sensory analysis of sub-samples from all muscles. Due to the variability in the level of enhancement, samples were selected to have equal levels of enhancement across treatment (Feeding and Enhancement). Samples were evaluated for juiciness, tenderness, beef flavor, saltiness, and off-flavor. Steak samples were also evaluated for cook loss and Warner-Bratzler shear force.

Findings

Carcass Characteristics

Selecting on back-fat thickness resulted in only small differences for the weight and pH of evaluated muscles. While there was little difference observed in the L^* , a^* and b^* values of *Longissimus* samples, the % moisture and % lipid was lower and higher, respectively, in Fed samples versus Non-Fed samples.

Percent Enhancement

The mean values for percent enhancement varied within muscles, but varied even more across muscles. This variation in percent enhancement seems to be even greater when enhancing meat from older animals.

Percent Purge and pH

Muscles from those carcasses that were selected as Fed had significantly more purge for the *Longissimus*, *Complexus*, and *Teres major* muscles, and tended to have more purge for the *Triceps brachii* muscle, than those from Non-Fed carcasses. Those samples that were enhanced with citrate may have had less water holding capacity as indicated by higher percent purge. There were no differences in pH between the Fed and Non-Fed muscles, even though the pH was increased over the non-enhanced samples. Six of the muscles receiving the Citrate treatment had significantly higher pH than those enhanced with Salt. This is expected as the citrate brine was almost 0.3 pH units higher than the salt brine.

Sensory Analysis

Juiciness and tenderness were minimally affected by either feeding or enhancement treatments. Beef flavor increased in the *Longissimus* when enhanced with Citrate, whereas beef flavor increased in the *Complexus*, and was trending to increase in the *Teres major*, when enhanced with Salt. For all muscles within each treatment, the average off-flavor scores were numerically small.

Cook Loss and Warner-Bratzler Shear Force

Minimal differences were observed for cook loss and Warner-Bratzler shear force due to treatments. Warner-Bratzler shear force was decreased in the *Longissimus* when enhanced with Citrate.

Visual Evaluations

Subjective color was increased in the Fed samples at day 2 for the *Supraspinatus*, and at day 3 for the *Infraspinatus* and *Supraspinatus*, and was trending to be higher at day 2 for the *Infraspinatus* and *Triceps brachii*. Discoloration scores due to feeding resulted in few significant differences. The use of citrate resulted in higher subjective scores at day 0 for the *Infraspinatus*, *Supraspinatus*, and *Longissimus*, while trending towards being higher in the *Triceps brachii*. The higher subjective scores would indicate a darker product, which would be expected in the Citrate samples because of the higher pH of the brine solution with which the samples were enhanced.

Microbial counts

At day 0 (11 days after enhancement), samples that were enhanced with the Salt brine had a higher Log CFU/cm² value than did the Citrate samples. However, at day 3, the Salt samples had a lower value.

Implications

Those muscles from forequarters selected as Fed had a higher percent purge in three of seven muscles when compared to muscles selected from Non-Fed forequarters. The use of citrate in a brine solution as a replacement for salt resulted in muscles that had a higher pH, and potentially, a higher percent purge. Results indicated that sensory analysis ratings for juiciness and tenderness were minimally affected by enhancement treatment. Enhancement also had limited impact on off-flavor, indicating that the use of citrate did not contribute to, or further, any associated off-flavors. The use of citrate resulted in darker color in some of the samples measured but less discoloration after 3 days in all muscles samples. In addition, microbial counts were higher after 3 days storage in the Citrate samples.

While the use of sodium citrate did result in some samples with more purge and a darker color, it was able to improve the color stability of the product when evaluated at 3 days. Adding citrate into a brine solution may help to prevent premature browning of product in retail display and extend product shelf-life.

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