The Influence of Increasing Carcass Weight on Chilling Rate, Aging Response and Meat Quality of Three Beef Muscles


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The Influence of Increasing Carcass Weight on Chilling Rate, Aging Response and Meat Quality of Three Beef Muscles: Project Summary

Background

The average weight of a beef carcass in the U.S. has increased from 747 pounds in 1995 to 867 pounds in 2016 according to the 2016 National Beef Quality Audit (Boykin et al., 2017). Further, 12.4% of carcasses were reported to have a carcass weight of 1000 pounds or greater. Many packers still utilize spray chilling methods adopted in the 1980’s and 1990’s, which were designed for smaller carcasses that were about a 100 pounds lighter (Savell, 2012). As chilling methods have not changed drastically in recent years, heavier carcasses are at risk of not chilling properly. Furthermore, chilling rates have been reported to affect tenderness and meat quality in beef products (Kim et al. 2012; Cruzen et al. 2015). The current trend towards increased carcass weights could result in a variation in chilling rates that impact the development of quality traits that are important to consumers.

Objectives

The objectives of this study were to 1) Determine the influence of carcass weight on chilling rate of the round, loin, and chuck; 2) Determine the influence of carcass weight on shear force, palatability, and postmortem proteolysis of eye of round, strip loin, and Denver cut steaks from USDA Choice and USDA Select carcasses at 5, 10, and 14 days of postmortem aging; 3) Determine the influence of carcass weight on sarcomere length and ultimate pH of eye of round, strip loin, and Denver cut steaks from USDA Choice and USDA Select carcasses; and 4) Collect preliminary data on the efficacy of thermal imaging technology as a means to assess beef carcass chilling.

Methods

Beef carcasses of varying weights groups (light weight [650-750 lbs], medium weight [850-950 lbs], heavy weight [1025-1150 lbs]) were selected on the slaughter floor of a commercial beef packing plant. Internal temperature of the round, loin and chuck was tracked using data logging thermometers after slaughter during the carcass chilling process (26 hour duration). Lower 1/3rd USDA Choice (20 light weight, 20 medium weight and 20 heavy weight) and USDA Select (20 light weight, 20 medium weight, and 16 heavy weight) were selected after carcasses were graded. Each carcass was tracked through fabrication and chuck rolls, strip loins, and eye of rounds were collected for analysis. Steaks were fabricated from each cut and aged for 5, 10, or 14 days postmortem for determination of shear force, sensory attributes, postmortem proteolysis, and sarcomere length. A second experiment was conducted where 51 carcasses were used to collect preliminary data on the application of thermal imaging to measure chilling rate. All carcass internal temperatures were tracked using data logging thermometers and thermal images collected at the time that each carcass entered the cooler, 3, 6, 12, and 24 hours of chilling.

Important Findings

As expected, the heavy weight carcasses chilled more slowly, middle weight carcasses chilled intermediately, and light weight carcasses chilled most rapidly in the round, loin and chuck. Strip loin steaks from light weight carcasses had the highest shear force values and lowest overall liking scores in day 5 steaks, however at day 10, the shear force decreased and overall liking increased to where steaks were similar to other weight groups. Proteolysis data of desmin support that light weight carcasses have the least degradation at day 5 and increase by day 10 of aging. Middle weight carcasses generally had the greatest overall liking scores from sensory analysis across all muscles. Thermal imaging data indicates thermal images of carcasses after slaughter are associated with chilling rate.
Industry Impact

The strip loin, eye of round, and Denver cut steaks are influenced differently by increased carcass weights and USDA quality grade. Middle weight carcasses have most positive palatability traits in USDA Select and lower 1/3rd USDA Choice strip loin and Denver cut steaks. Moderate to strong correlations between internal temperature and maximum surface temperatures of the chuck, loin, and round as captured in thermal images indicate thermal imaging may be an effective way to track carcass chilling.

Figures

Figure 1. Thermal Image collection and resulting thermal image of the beef round primal.

![Thermal Image]

Figure 2: Top graph: Beef loin primal internal temperature decline. Temperature recorded at 10.16 cm deep in the longissimus lumborum muscle of the loin primal. Temperature reported every 30 minutes. Heavy = carcasses weighing between 465-522 kg, Middle = carcasses weighing between 385-431 kg, and Light = carcasses weighing between 295-340 kg. LC = USDA low choice quality grade carcasses and Se = USDA Select quality grade carcasses. Bottom left: Overall liking for USDA Select New York Strip. Bottom right: Overall liking for USDA Choice New York Strip (lower 1/3 choice).
References:


