Do Carcass Weight and Ribeye Size Impact Beef Palatability?

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Do Carcass Weight and Ribeye Size Impact Beef Palatability?: Project Summary

Background

The foodservice sector of the meat industry claims a substantial portion of beef consumption across the United States, with beef representing approximately 40% of the share of all foodservice menu items (Dunn et al., 2000). Therefore, maintaining uniformity among beef cuts while meeting consumer expectations is of utmost importance within an industry that is ever-changing. According to the National Beef Quality Audits (Boleman et al., 1998; Boykin et al., 2017a, 2017b; Garcia et al., 2008; Gray et al., 2012; McKenna et al., 2002; Moore et al., 2012), average hot carcass weights and ribeye areas have steadily increased over the past decades. Moreover, challenges associated with merchandising steaks from heavier carcasses and larger ribeye sizes have been identified for both retail and foodservice (Dunn et al., 2000). Therefore, understanding how carcass weight and ribeye size may influence subprimals is of great importance.

Objectives

The objectives of this study were to 1) determine if carcass weight, ribeye size, or steak-portioning method (steaks cut to a consistent thickness of 3.18 cm, or a consistent portion weight of 340) influence tenderness and consumer sensory characteristics of beef steaks, and 2) assess whether variation in beef carcass weight and ribeye size affect selected subprimal yields and muscle-to-muscle variation.

Methods

Objective 1 – Carcass weight, ribeye area, and beef palatability

Beef carcasses (n = 90) were selected at a large commercial beef harvest and processing facility. Selected carcasses were USDA Choice (Ch-) quality grade (Small marbling only) and met the following 3 × 3 treatment scheme of varying ribeye size (REA) and hot carcass weight (HCW) categories. After selection, carcasses were fabricated, and one strip loin was obtained from each carcass (n = 90).

All strip loins were aged under refrigeration (0 to 2°C) for 14 days (“Day 0” was defined as the day of fabrication and vacuum packaging), then removed from their packaging and trimmed of any visible discoloration or remaining excess surface fat. After trimming, strip loins were blade tenderized using a Ross™ Tenderizer (Series No. 1060; Ross Industries Inc, Midland, Virginia). A Marel® intelligent portion cutter (M Series 3000, Marel®, Lenexa, KS) was used to create a cut pattern that generated three steaks per portioning method from each strip loin for a total of 6 steaks per strip loin (n = 540 total steaks). Portioning methods for cutting were defined as: (1) consistent thickness at 3.18 cm (1.25 inches; n = 270 steaks), and (2) consistent portion weight at 340 g (12 ounces; n = 270 steaks). Steaks were labeled for consumer sensory panel (n = 360) or Warner Bratzler Shear (WBS) force (n = 180) and kept frozen (-20°C) until analyses were performed.

Frozen steaks were thawed under refrigerated conditions (2 to 4°C) for approximately 28 h before cooking. All steaks were cooked on grated, non-stick electric grills (Figure 1) preheated to a surface temperature of 177 ± 2°C. Internal steak temperatures were monitored and steaks were flipped at an internal temperature of 35°C and removed from the grill when the final internal temperature reached 70°C. Cooked steaks intended for WBS force evaluation were placed on metal trays in a single layer, covered with plastic wrap, and stored at refrigerated conditions (2 to 4°C) for approximately 12 to 16 h. Steaks assigned to consumer panels were held in an Alto-Shaam oven set at 60°C for no more than 20 min before serving to consumer panelists. WBS force steaks (n = 180) were allowed to equilibrate to room temperature before being trimmed of visible connective tissue to expose muscle fiber orientation. From the M. longissimus lumborum, six 1.3-cm cores were removed parallel to the muscle fibers and were sheared once.

Consumer sensory panel procedures were approved by the Texas A&M Institutional Review Board for Use of Humans in Research (Protocol number: IRB2019-0820M). Panelists (n = 220) were recruited from the Bryan/College Station area using an existing consumer database. Sensory panel steaks (n = 360) were cooked as described previously, were cut into cuboidal portions (approximately 1.27 cm x 1.27 cm x steak thickness) and served warm to panelists. Panelists were asked to evaluate samples using 9-point scales (1 = dislike extremely; 9 = like extremely) for overall liking, flavor liking, tenderness liking, and juiciness liking.
Objective 2 – Carcass weight, ribeye area, and composition

Beef carcasses (n = 36) from an upper two-thirds Choice, branded program were selected at a collaborating beef packer to fill a 3 × 3 treatment structure of HCW and REA categories. From selected carcasses, left and right sides were assigned randomly to one of two trials. For trial 1, five individual muscles were removed, in their entirety, via dissection from each carcass side, trimmed practically free of fat, weighed, and measured. In trial 2, carcass sides were subjected to conventional fabrication methods and resulting subprimals (n = 6 per carcass side) were trimmed, weighed, and measured.

In total, twelve dimensional measurements were obtained from each subprimal and individual muscle (Figure 2). Specifically, length of each dorsal, medial, and ventral surfaces, in addition to width, height, and circumference at the anterior, median, and posterior locations of each subprimal and individual muscle were obtained.

Statistical analyses

All data were analyzed using JMP® Pro, Version 14.0.0 (SAS Institute Inc., Cary, NC). Consumer demographic frequencies were determined using the Distribution function of JMP. All other data were analyzed using the Fit Model function to perform analysis of variance (ANOVA). Main effects included REA, HCW, and portioning method (weight versus thickness; cooking data only) as well as the REA × HCW interaction. Least squares means comparisons were conducted when appropriate using Student’s t-test with an alpha-level 0.05.

Important Findings

It appears that there are combinations of ribeye sizes and carcass weights where steaks from strip loins, whether portion cut for thickness or portion cut for weight, have WBS force values (Tables 1 and 2) and sensory attributes that are superior to other combinations, even at the same marbling score. Even though these differences are significant, there is comfort in that all of the WBS and palatability ratings are generally well within what would be considered highly acceptable by most comparisons to benchmark information. Nevertheless, it is troubling that combinations of ribeye sizes and carcass weights played such a significant role in palatability attributes of these steaks, potentially creating more variation in possible consumer acceptance of beef. From a carcass composition standpoint, it is not surprising that weights, sizes, and shapes of subprimals or individual muscles varied significantly when sourced from carcasses of different ribeye size and carcass weight combinations.

Industry Impact

Determining why such variation in tenderness and consumer acceptance exists due to ribeye area and carcass weight should be of paramount importance to the beef industry moving forward. The amount of beef that is portion cut with advanced computer-assisted technology through foodservice providers or case-ready facilities will continue to increase, which makes it of greater importance to understand how these dimensions impact the products that reach consumers, whether they are dining out or are dining at home. Gathering of this information is the first step towards working with the industry to determine whether there are sourcing options that improve the quality and consistency of beef for certain marketplace channels.
Figures

Figure 1. Cooking of strip loin steaks for Objective 1.

Figure 2. Measurement of muscles for Objective 2.

Tables

Table 1: Least squares means of Warner-Bratzler Shear force values (N) for strip loin steaks portioned by thickness (3.18 cm) and stratified by ribeye size × carcass weight categories.

<table>
<thead>
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<th>Carcass weight category</th>
<th>Ribeye size category</th>
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<th>15.0 to 15.9 sq. in.</th>
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<td>20.80 ab</td>
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<tr>
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<td>15.52 cd</td>
<td>18.54 abc</td>
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<td>P-value</td>
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a-d Least squares means lacking common superscript letters differ (P < 0.05).

Table 2: Least squares means of Warner-Bratzler Shear force values (N) for strip loin steaks portioned by weight (340 g) and stratified by ribeye size × carcass weight categories.

<table>
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<th>Carcass weight category</th>
<th>Ribeye size category</th>
<th>13.0 to 13.9 sq. in.</th>
<th>14.0 to 14.9 sq. in.</th>
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a-e Least squares means lacking common superscript letters differ (P < 0.05).
References


