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Retail yields and palatability evaluations of individual muscles from wet-aged and dry-aged beef ribeyes and top sirloin butts that were merchandised innovatively

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ABSTRACT

Paired ribeyes ($n = 24$) and top sirloin butts ($n = 24$) were dry-aged or wet-aged for 35 days before being merchandised as individual muscles: *M. spinalis thoracis*, *M. longissimus thoracis*, *M. gluteobiceps*, and *M. gluteus medius*. Wet-aged subprimals had greater saleable yields than dry-aged. Dry-aged *M. spinalis thoracis* and *M. gluteobiceps* received lower consumer overall like and flavor ratings than did wet-aged; interior muscles — *M. longissimus thoracis* and *M. gluteus medius* — did not differ. Trained panelists found higher musty and putrid flavors for dry-aged muscles closer to exterior surface. These flavors may have contributed to lower consumer overall like and flavor ratings for dry-aged *M. spinalis thoracis* and *M. gluteobiceps*. Using innovative styles to cut beef allows for greater merchandising options. However, development of undesirable flavor characteristics may be more pronounced when exterior muscles — *M. spinalis thoracis* and *M. gluteobiceps* — are exposed during dry-aging to extreme conditions and are consumed individually.

1. Introduction

A challenge facing the U.S. beef industry is increasing size and weight of cattle, carcasses, and cuts (Boleman et al., 1998; Garcia et al., 2008; Lorenzen et al., 1993; McKenna et al., 2002; Moore et al., 2012). As a potential solution to this problem, West et al. (2011) used the Beef Alternative Merchandising cutting styles outlined in the SIMPLYBEEF Guide produced by the National Cattlemen's Beef Association (2009b, 2009c). This study showed that despite increased labor costs and yield losses, these methods create more uniformly portioned products. There is no information on the acceptability of this style of cutting for dry-aged beef.

The two most common forms of aging are dry-aging and wet-aging. Smith et al. (2008) described dry-aging as unpackaged meat aged at controlled temperatures and humidity. Wet-aging refers to extended storage of meat in vacuum-sealed packages at refrigeration temperatures. Since the introduction of vacuum-packaged boxed beef, wet aging has continued to be the most commonly used industry aging system due to its increased ease and flexibility of storage (Savell, 2008). There appears to be an increase in number of establishments preparing dry-aged beef for upscale retail and foodservice markets, despite greater space and facility requirements to control temperature, relative humidity, and airflow.

Despite research in wet-aging versus dry-aging within recent years (Ahnström, Seyfert, Hunt, & Johnson, 2006; Campbell, Hunt, Levis, & Chambers, 2001; DeGeer et al., 2009; Laster et al., 2008; Lautenschläger, 2012; Sitz, Calkins, Feuz, Umberger, & Eskridge, 2006; Smith et al., 2008), there is still a need to understand the complex flavor profile of dry-aged beef. Utilizing the Beef Alternative Merchandising cutting styles provides a unique perspective of how individual muscles are influenced by dry-aging.

The objectives of this study were (1) to understand the influence of aging method — dry-aging versus wet-aging — had on the saleable yield of cuts generated using innovative cutting styles, (2) to identify consumer acceptance and(or) preference of beef steaks from four different muscles based on aging style, and (3) to better determine the unique flavor profiles specific to dry-aged and wet-aged steaks.

2. Materials and methods

2.1. Product selection

Beef carcasses ($n = 12$) grading U.S. Department of Agriculture (1997) Choice were identified and segregated at a major beef processor at approximately 48 h postmortem. Average characteristics were hot (unchilled) carcass weight, 407.8 kg; *M. longissimus thoracis* area at the 12th rib, 100.2 cm^2; and adjusted fat thickness, 12th rib, 1.5 cm. Both sides from each carcass were fabricated, and Institutional Meat Purchase Specifications (NAMP, 2010; U.S. Department of Agriculture, 2010) Beef Loin, Top Sirloin Butt, Boneless (IMPS 184) and Beef Rib, Ribeye, Lip-On (IMPS 112A) subprimals were obtained, labeled with carcass number and side (left or right), vacuum packaged, and boxed.

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Boxed subprimals then were shipped via a refrigerated truck to a commercial facility for aging.

2.2. Aging treatments

Subprimals ($n = 24$ for ribeyes and $n = 24$ for top sirloin butts) were separated into one of two treatments, dry-aging or wet-aging. All odd numbered, left subprimals were assigned to dry-aging and all odd numbered, right subprimals were assigned to wet-aging. Similarly, all even numbered, left subprimals were allocated to wet-aging and, all even numbered, right subprimals were allocated to wet-aging.

Vacuum-packaged subprimals designated for wet-aging were placed under refrigeration temperatures (3.0 ± 0.7 °C). Those assigned to the dry-aging group were weighed in the bag (in-bag weight), then taken out of the bag and reweighed (out of bag weight). The removed vacuum package bags were rinsed with water, dried, and weighed to determine purge loss by subtraction. The subprimals identified for dry-aging were placed in a dry-aging cooler (4.0 ± 1.1 °C; 98.1% Rh) on a perforated, plastic rack. Temperature and relative humidity of the cooler were monitored using a continuous data logging device and probe (Model TM325; Dickson Data, Addison, IL). Fans were used to enhance air circulation, and UV lights were used to inhibit mold growth. Every 3 to 5 days, subprimals were flipped to allow for more uniform drying in accordance with the facility's traditional dry-aging practices. After 35 days of aging, dry-aged subprimals were placed in polyethylene bags and boxed. Both wet-aged and dry-aged subprimals were shipped under refrigeration to the Rosenthal Meat Science and Technology Center at Texas A&M University for fabrication into retail cuts.

2.3. Retail cutting tests

A retail market environment was simulated in a refrigerated cutting room at the Rosenthal Meat Science and Technology Center for the purpose of conducting retail yield tests. All subprimals were cut according to the Beef Alternative Merchandising (BAM) cutting styles outlined in the SIMPLYBEEF Guide (National Cattlemen's Beef Association, 2009a, 2009c), following the procedures used by West et al. (2011). An experienced meat cutter with extensive knowledge and experience with the BAM cutting styles fabricated the subprimals.

After each cutting test, trained Texas A&M University personnel recorded weights of all fabricated components: steaks, lean trimmings, stew meat, fat trimmings, heavy connective tissue, and crust (dried lean and fat surfaces from dry-aged cuts). Weights were summed to ensure that at least 99% of the initial subprimal weight was recovered. Individual steak length, width, and weight were measured and recorded before vacuum packaging, labeling, and freezing (−23 °C).

2.4. Wet-aged cutting tests

2.4.1. Beef Rib, Ribeye, Lip-On (IMPS #112A)

The lip was removed from the ribeye at the natural seam. The *M. spinalis thoracis* was removed following the natural seam, and the heavy connective tissue and intermuscular fat were removed. The *M. spinalis thoracis* was cut across the grain into 3.81 cm-wide URMIS 1254 — Beef Ribeye Cap Steak Boneless (BAM). The *M. complexus* and exposed intermuscular fat were removed from the *M. longissimus thoracis*. Beginning on the anterior end of the *M. longissimus thoracis*, 3.81 cm thick URMIS 1253 — Beef Ribeye Filet Boneless (BAM) steaks were removed until they approached the size that required splitting the remaining *M. longissimus thoracis* longitudinally in half to produce similar-sized filets. This portion was split into two logs, and each was cut into 3.81 cm-wide filets. Any residual pieces were weighed as stew meat.

For dimensional descriptions of the URMIS 1254 — Beef Ribeye Cap Steak Boneless (BAM), length was determined by measuring the most anterior to the posterior point, and width was determined by measuring the dorsal to the ventral edge. The URMIS 1253 — Beef Ribeye Filet Boneless (BAM) was measured with the medial to lateral edge representing length and dorsal to ventral representing width.

2.4.2. Beef Loin, Top Sirloin Butt, Boneless (IMPS #184)

The *M. gluteobiceps* (IMPS 184D — Beef Loin, Top Sirloin, Cap (IM)) was removed, cut into 2.54 cm-thick steaks across the grain, and steaks were trimmed to no more than 0.3 cm external fat to create URMIS 1421 — Beef Loin Top Sirloin Cap Steak Boneless (BAM). The *M. gluteus accessorius* and *M. gluteus profundus* were removed from the remaining sirloin section and were weighed as lean trimmings. The remaining *M. gluteus medius* was divided into thirds (anterior to posterior, approximately parallel to the muscle fiber orientation), and each was cut into 3.81 cm-thick URMIS 1323 — Beef Loin Top Sirloin Filet Boneless (BAM).

The URMIS 1421 — Beef Loin Top Sirloin Cap Steak Boneless (BAM) length was measured from the medial to lateral point, and width was measured anterior to posterior. Additionally, the longest point on the steak surface was measured as length on the URMIS 1323 — Beef Loin Top Sirloin Filet Boneless (BAM), and width was measured perpendicular to this point.

2.5. Dry-aged cutting tests

2.5.1. Beef Rib, Ribeye, Lip-On (IMPS #112A)

Dry-aged ribeyes were weighed before cutting to determine an initial weight. Exterior dried surfaces (crust) were removed and weighed. Steaks were cut and measured in the same manner as the wet-aged steaks.

2.5.2. Beef Loin, Top Sirloin Butt, Boneless (similar to IMPS #184)

Dry-aged sirloins were weighed before cutting to determine an initial weight. Crust was removed and weighed. External fat was trimmed to 0.3 cm and weighed as fat trimmings. Subprimals were fabricated and measured using the same procedure as the wet-aged subprimals.

2.6. Consumer sensory panel

Consumer panelists ($n = 107$) were recruited from the Bryan–College Station metropolitan area using an existing consumer database. Upon arrival at the sensory facility on the campus of Texas A&M University, panelists completed a demographic survey.

Steaks selected for sensory evaluation were removed from the freezer and thawed in the cooler (~2 °C) for 48 h. Steaks were cooked on pre-heated (177 °C at the grill surface) indoor electric grills (Hamilton Beach Indoor/Outdoor Grill, Hamilton Beach/Proctor Silex, Inc., Southern Pines, NC), and steak internal temperatures were monitored continuously using Omega trendicators (Omega Engineering, Inc., Stamford, CT) fitted with type-T thermocouples. Steaks were cooked to an internal temperature of 35 °C, flipped, and cooked to a final temperature of 70 °C. Cooked steaks were portioned into cuboidal samples (1.27 cm × 1.27 cm × cooked steak thickness). Samples representing individual subprimals were served randomly to panelists seated in individual sensory booths equipped with red lights.

Panelists evaluated eight samples using 9-point scales for overall like (9 = like extremely, 1 = dislike extremely), flavor like (9 = like extremely, 1 = dislike extremely), level of flavor (9 = extremely flavorful or intense, 1 = extremely bland or no flavor), beef flavor like (9 = like extremely; 1 = dislike extremely), level of beef flavor (9 = extremely flavorful or intense, 1 = extremely bland or no flavor), tenderness like (9 = like extremely, 1 = dislike extremely), level of tenderness (9 = extremely tender, 1 = extremely tough), juiciness like (9 = like extremely, 1 = dislike extremely), and level of juiciness (9 = extremely juicy, 1 = extremely dry). Consumers were given US$20 for their participation in this study.