Final Report

Determination of the effect of branding on consumer palatability ratings of beef strip loin steaks of various quality levels and ground beef of various lean points from different subprimals

Department of Animal Sciences and Industry, Kansas State University, Manhattan, KS 66506

Phone: (785) 532-3469
E-mail: travisoquinn@ksu.edu

Principal Investigator: T. G. O'Quinn

Introduction

In 1978 Certified Angus Beef® (CAB®) was founded as the nation's first branded beef program. The program was founded with the belief that by selecting beef that meets a specific set of quality standards that the overall beef eating experience can be consistently guaranteed for consumers. This commitment to eating quality has helped CAB® remain the largest and most influential branded beef program for the past 37 years. Additionally, the demand for CAB® products has continued grow over the past seven years, rapidly outpacing the growth in demand of Choice beef (CAB, 2015). This at a time when cattle supplies are at their lowest point in the past 60 years, resulting in record high beef cutout values (USDA, 2015b). Consumers' willingness to continue to purchase premium CAB® products, despite record high prices, gives a clear indication of the quality level of the brand and beef consumers' desires for dependable and repeatable eating quality.

Results of the National Retail Meat Case Study have shown that the percentage of branded beef products has increased from 42% in 2004 to 63% in 2010 (NCBA, 2010). This number has likely continued to increase over the past 5 years in the time since the most recent audit was conducted. This percentage has grown as retailers, suppliers, and producers work to capture added value of beef through product differentiation and branding. Today, the USDA-AMS monitors and certifies product for 99 different Certified Beef programs (USDA, 2015a). Of this, 66 include "Angus" as part of the brand name or as a breed-specific product specification (USDA, 2015a). This large number of "Angus" programs attempt to capture the value associated with breed, due in large part to the success of CAB®.

Ground beef remains an important part of the beef demand complex. Ground beef represents the largest total volume of beef sales for both foodservice and retail, representing more than 37% of total revenue for both segments (Speer et al., 2015). Additionally, ground beef prices have steadily increased over the past decade, with a much more rapid increase in value over the past 5 years (Speer et al., 2015). Traditionally, ground beef has been marketed as a commodity product, however, with retail ground beef prices eclipsing $4/lb this past year, many retailers and suppliers are looking for ways to capture additional value from this category. In 2010, 51% of ground beef at retail was marketed without a brand (NCBA, 2010). This large number of unbranded products represents a large opportunity for product differentiation and value creation in this segment.

Numerous studies have demonstrated the economic value of branded beef programs (Feldkamp et al., 2005; Parcell and Schroeder, 2007; Schulz et al., 2012). Furthermore, it is well documented that beef products that have increased marbling levels, such as CAB®, result in greater consumer eating satisfaction (Savell et al., 1987; O'Quinn et al., 2012; Corbin et al., 2015). However, no current studies have evaluated the palatability-related value of beef branding. Most published reports detailing beef palatability differences are the result of "blind" consumer testing in which panelists are not informed of the product type before evaluation.

However, consumer purchasing decisions and product evaluation in "real-world" settings are not "blind". Consumers are aware of the brand, grade, and numerous other factors (price, cut, visual characteristics, etc.) of the product before they ever take their first bite, both in-home and in restaurant.

It was therefore the objective of this study to determine the effect of branding on consumer perceptions of steak and ground beef palatability and determine the palatability-related value associated with CAB® and Angus branding.

Materials and Methods

Steak Panels

Treatments and Preparation

Beef strip loins (IMPS #180, NAMP, 2010) were selected to equally represent five quality levels - USDA Select, Choice (Low Choice marbling), Prime, CAB®, and Select from phenotypical Angus cattle (Angus Select) (n = 40; 8 / treatment). Product was selected by trained Kansas State University (KSU) personnel from a commercial beef processor in Nebraska. Upon selection, the research team recorded USDA marbling score, carcass lean and skeletal maturity, ribeye area, fat thickness, hot carcass weight, and percentage kidney, pelvic, and heart fat (Table 1). Strip loins were vacuum-packaged and transported, under refrigeration (2ºC) to the KSU Meat Science Laboratory where they were allowed to age in the absence of light at $0 - 4$ºC for 21 days prior to steak fabrication.

After completion of the 21 day aging period, all strip loins were fabricated into 2.5-cm thick steaks. When designating steaks for consumer testing, consecutively cut steaks were paired, with one steak from each pair assigned to blinded consumer testing and the other to non-blinded testing. Within each strip loin, steaks were collected from both the anterior portion and the posterior portion for consumer analysis. Following fabrication, steaks were individually vacuum-packaged and frozen (-20ºC) until subsequent analysis.

Consumer Panel Testing

Consumer testing was conducted at the KSU Animal Science building. Consumer panelists (n = 112) who regularly consumed beef were recruited from Manhattan, KS and the surrounding communities and were paid to participate in the study. Panelists were only allowed to participate one time. Consumer sampling was conducted in a large room, under fluorescent lighting. Five panel sessions were conducted with 21 consumers and one panel session of 7 consumers. Each panel lasted approximately 1 h.

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Steaks were thawed at 2 – 4ºC for 24 h prior to consumer testing and were cooked, unseasoned, to a medium (71ºC) degree of doneness in a convection oven (DFG-100-3 Series, GS Blodgett Co., Inc. Burlington, VT) with temperatures monitored by thermocouples attached to a Doric Mini-trend Data Logger (Model 205 B-1-c OFT, Doric Scientific, San Diego, CA). Following cooking and a two minute rest period, steaks were cut into 1 cm cubes and immediately served to 7 predetermined consumers.

Consumers were provided utensils, an expectorant cup, ballot, and palate cleansers to use between samples (unsalted crackers and apple juice). Prior to the start of each panel session, panelists were given verbal instructions explaining the ballot, testing procedures, and use of palate cleansers. The ballot included a brief demographic questionnaire used to characterize the gender, household size, income level, education level, ethnicity, and beef consumption habits of consumers. Additionally, consumers completed a beef brand awareness and beef purchasing motivator questionnaire prior to sample evaluation.

Serving of samples was conducted in two rounds. In the first round, consumers were served one sample from each treatment, in a random order, blind (ie: panelists were only informed that all samples evaluated were beef steaks). Each sample was evaluated for tenderness, juiciness, flavor, and overall liking on 100 mm line scales anchored at both ends with descriptive terms; 100 = extremely juicy, tender, and like extremely, 0 = extremely tough, dry, and dislike extremely. Additionally, scales were anchored midway with a neutral point. Moreover, consumers rated each trait as either acceptable or unacceptable and classified the sample as unsatisfactory, everyday quality, better than everyday quality, or premium quality.

Following completion of the first round, all ballots were collected and consumers received a new ballot for evaluation of samples during the second round of testing. Testing procedures for round two were identical to round one, however, prior to the serving of each sample, consumers were given a description of the product to be tested. Consumers were informed verbally of the quality level of the product (Select, Choice, Prime, CAB®, or Angus Select) as well as were presented with a visual image (CAB® brand logo or USDA shield) prior to evaluation of each sample. Samples evaluated in round two were paired with samples from round one, allowing for a direct comparison of consumer ratings and evaluation of the effects of branding and grade identification on palatability perception.

Statistical Analyses

Statistical analyses were conducted using SAS (Version 9.4; SAS Inst. Inc., Cary, NC). Consumer panel data were analyzed using PROC GLIMMIX with an $\alpha = 0.05$. The model included the fixed effect of quality level and the random effect of panel. Additionally, all acceptability data was analyzed with a model that included a binomial error term. All demographics were summarized using PROC FREQ.

Ground Beef Panels

Treatments and Preparation

Six treatments (6 10 lb-chubs / treatment) were selected to represent a variety of product types, fat levels, and brands and included: 90/10 CAB ground sirloin, 90/10 commodity ground beef, 80/20 CAB® ground chuck, 80/20 commodity ground chuck, 80/20 commodity ground beef, and 73/27 CAB® ground beef. Ground beef was transported under refrigeration to the KSU Meat Laboratory and stored at 0 - 4 °C prior to patty formation. Ground beef chubs were fabricated, after an average of 8 days aging from box date, into 1/3 lb. patties using a patty former (Super Model 54 Food Portioning Unit, Hollymatic, Countryside, Il).

Patties were identified as pairs, with two 1/3 lb patties representing a single sample. When designating patties for consumer testing, consecutively formed patty pairs were matched, with one pair from each set assigned to blinded consumer testing and the other to non-blinded testing. Within each chub, patties were collected from across the length of the chub for consumer analysis. Patties were then vacuum-packaged and frozen (-20ºC) until subsequent analysis.

Consumer Panel Testing

Consumer recruitment and testing procedures for ground beef were similar to steak panels. For cooking, patties were thawed at 2 – 4ºC for 24 h prior to consumer testing. Patties were then cooked, unseasoned, to 74ºC in a convection oven (DFG-100-3 Series, GS Blodgett Co., Inc. Burlington, VT). Following cooking, patties were quartered and 1 piece was immediately served to 7 predetermined consumers.

Consumers (n = 112) were given instructions and provided the same materials previously described for steak panels. The ballot included the same demographic, purchasing motivator, and brand awareness questionnaires. Each sample was evaluated for tenderness, juiciness, texture, flavor, and overall liking on 100 mm line scales anchored at both ends with descriptive terms; 100 = extremely juicy, tender, and like extremely, 0 = extremely tough, dry, and dislike extremely. Additionally, as with steak panels, scales were anchored midway with a neutral point. Moreover, consumers rated each trait as either acceptable or unacceptable and characterized the sample into one of four perceived quality levels.

As with steak panels, serving of samples was conducted in two rounds, the first including blind testing and the second with the product categories identified for panelists. Consumers were informed of the lean point, subprimal, and brand (CAB®) of each sample prior to sample evaluation in the second round. Similar to steak panels, samples evaluated from the same treatment in each round were paired, allowing for a direct comparison of the change in palatability ratings due to product disclosure.

Statistical analyses were conducted using SAS (Version 9.4; SAS Inst. Inc., Cary, NC). Consumer panel data were analyzed using PROC GLIMMIX with an $\alpha = 0.05$. The model included the fixed effect of quality level and the random effect of panel. Additionally, all acceptability data was analyzed with a model that included a binomial error term. All demographics were summarized using PROC FREQ.

Results and Discussion

Steak Panel

Consumer Demographics, Purchasing Motivators, and Brand Awareness

The demographic profile of consumers who participated in sensory testing is presented in Table 2. For steak panels, a similar number of males (42.2%) and females (57.8%) participated, with 9.9% from a single person household, 17.1% from a 2 person household, and the majority (72.9%) from households of 3 or more people. The majority (67.0%) of participants were married. Additionally, a wide age range of consumer panelists were used, with 40% of panelists from age 30 to 49. The majority of panelists were Caucasian (72.5%) followed by African-American (15.6%) and Hispanic (10%). More than three fourths (77.4%) of panelists reported an annual household income level of greater than $50,000, with 26.1% reporting an income level of over $100,000. This income level is likely due to more than half (62.9%) of participants being college graduates or having received post-graduate degrees. All panelists were regular beef-eaters, with the majority (52.3%) eating beef more than 4 times a week. When asked which palatability trait was most important when eating beef, almost half (49.6%) of consumers identified "flavor" as opposed to tenderness (40.5%) or juiciness (9.9%). Moreover, 63.1% of consumers identified beef as the meat product with the most desirable flavor. The demographics of these panelists are similar to consumers used in previous beef palpability studies (O'Quinn et al., 2012; Hunt et al., 2014; Woolley, 2014; Corbin et al., 2015)

When asked to rate a list of beef purchasing motivators, consumers rated "price", "steak color" and "size, weight, and thickness" higher ($P < 0.05$) than all other traits evaluated (Table 3). "USDA grade", "marbling level", and "familiarity of cut" followed, rating higher ($P < 0.05$) than all production claims including: "Antibiotic use in the animal", "Local", "Growth Promotant Use", and "Animal Welfare". In a recent study by Woolley (2014), consumers ranked a comparable list of purchasing motivators very similar, rating "price", "color", "size, weight, and thickness", and "USDA grade" as more important than all animal production, nutrient, and product claims. These results show the importance consumers place on price and the intrinsic and visual traits of meats products sold at retail, indicating that branding and other marketing claims placed on meat packages are secondary in importance to most consumers compared to the appearance and price of the product.

Consumer brand knowledge and brand quality perception data are presented in Table 4. CAB® and all three USDA quality grades (Prime, Choice, and Select) were recognized by a similar ($P > 0.05$) percentage of consumers (all over 79%) and more recognized ($P < 0.05$) than all other brands evaluated. Angus Pride, Black Canyon Angus Beef, and Creekstone Farms were recognized by the lowest ($P < 0.05$) percentage of consumers (all less than 10%). Interestingly, more than 25% of consumers stated they recognized the generic "Angus Select" brand used exclusively for this study.

When asked to rate the quality level of each known brand, Prime was rated numerically the highest, with only CAB® and Angus Pride rated similar ($P > 0.05$; Table 4). Though significant differences were varied, Choice and Select rated numerically lower than all other brands. Consumers indicated that they perceived brands associated with the Angus breed as higher quality than generic USDA quality grades. For example, the generic Angus Select brand was numerically higher than USDA Select (7.45 vs 6.68). Though many of these difference were not statistically significant, these data overall indicate beef consumers' association of the Angus breed with a high quality product.

Consumer Taste Panels - Steak

Results from consumer taste panels are presented in Table 5. For blind taste testing, tenderness, juiciness, flavor, and overall liking scores increased with increased marbling level. Prime rated higher ($P < 0.05$) than all treatments, other than CAB®, for tenderness and higher ($P < 0.05$) than all treatments for juiciness. No difference ($P > 0.05$) in tenderness or juiciness was observed among CAB®, Choice, Select, and Angus Select, however, both traits numerically increased with increased marbling. For flavor liking, Prime was rated higher ($P < 0.05$) than all treatments, other than CAB® and CAB® was rated higher ($P < 0.05$) than all lower marbled treatments other than Choice. The two Select treatments rated the lowest ($P < 0.05$) for flavor liking, rating similar to only Choice samples. Overall liking ratings followed the same trend as flavor liking, with Prime rating highest ($P < 0.05$) and similar to only CAB® and Select and Angus Select samples rated lower ($P < 0.05$) than all treatments other than Choice. For all traits, no differences ($P > 0.05$) were observed between Select and Angus Select treatments, with each trait rated almost identical between the two treatments.

Similar trends associated with marbling level were observed in the percentage of samples rated as acceptable for each palatability trait (Table 6). A higher ($P < 0.05$) percentage of Prime samples (98.24%) were rated acceptable for tenderness than all treatments other than CAB®. Moreover, Prime samples were rated acceptable for juiciness more than any other treatment ($P < 0.05$). CAB® samples were rated acceptable for tenderness a similar ($P > 0.05$) percentage of the time as Prime, Choice and Select samples and a similar ($P > 0.05$) percentage as all lower grading treatments for juiciness. A comparable ($P > 0.05$) number of CAB® and Choice samples were rated acceptable for tenderness, juiciness, and flavor. However, CAB® samples rated only

similar ($P < 0.05$) to Prime samples for overall acceptability, with both treatments having more than 90% of samples rated as acceptable, compared to less than 80% for all lower grading treatments.

These results are similar to numerous previous studies evaluating beef palatability of strip loin steaks of varied marbling level. In a trained panel, Emerson et al. (2013) demonstrated a linear increase in tenderness, juiciness, meaty/brothy flavor, and buttery/beef fat flavor as camera marbling scores increased from Traces to Moderately Abundant. Previous consumer studies have produced similar findings (O'Quinn et al., 2012; Woolley, 2014; Corbin et al., 2015; Legako et al., 2015). However, unlike Emerson et al. (2013), most consumer studies fail to detect statistically significant differences at each subsequent increase in marbling score. This is a result of the inherent consumer to consumer variation in beef eating expectation and experience. Results of the blind consumer testing in the current study show the same, expected increase in beef palatability as marbling level and USDA quality grade increase that has been reported by previous authors (O'Quinn et al., 2012; Woolley, 2014; Corbin et al., 2015).

However, when brands/grades were disclosed to consumers prior to testing of each sample, consumer ratings for each palatability trait were affected (Table 5). Prime samples were rated higher ($P < 0.05$) than all other samples for tenderness, juiciness, and overall liking, with CAB® sample no longer rated similar for tenderness or overall liking. CAB® samples were rated as more tender ($P < 0.05$) than both Select and Angus Select samples, whereas in blind testing, they were rated similar. Angus Select samples were rated comparable ($P > 0.05$) to CAB® samples for flavor, when in blind testing the CAB® samples were rated higher. CAB® samples were rated higher ($P < 0.05$) for overall liking than all lower grading product, contradicting the similar rating to Choice in blind testing. When comparing Select samples with Angus Select samples, Angus Select samples rated much higher ($P < 0.05$) for flavor liking, whereas previously no differences were observed.

Grade identification resulted in an increase ($P < 0.05$) in overall liking scores for three treatments: Prime (10.6%), CAB® (9.2%), and Angus Select (11.7%; Table 7). Additionally, flavor liking scores were increased ($P < 0.05$) for Prime, CAB®, and Angus Select samples 11.5%, 13.0%, and 16.3%, respectfully. No ratings decreased for Prime, CAB®, or Angus Select samples for any palatability trait. However, Select samples were rated 10.2% lower for tenderness when the grade was identified, but flavor, overall like and juiciness ratings remained relatively constant. Also, it is worth noting that all palatability traits decreased for Choice samples when the grade was known, indicating that grade knowledge negatively affected the palatability of these samples. This likely corresponds to the low quality perception of "USDA Choice" and "USDA Select" reported by consumers in Table 4. However, CAB®, Prime, and Angus Select samples received a positive "brand lift" for the opposite reasons.

Similar trends were observed in the percentage of samples rated as acceptable for each palatability trait (Table 6). In blind testing, a similar percentage of CAB® samples were rated as

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acceptable for juiciness as all lower grading samples. However, when brand was disclosed, a higher ($P < 0.05$) percentage of CAB® samples were rated as acceptable than Choice, Select, and Angus Select. Additionally, grade awareness resulted in a higher ($P < 0.05$) percentage of Prime samples rated as acceptable overall than all other grades, with more than 99% of Prime samples found acceptable overall.

Brand awareness did not result in as large of a change in the acceptability percentages of each palatability trait as observed in consumer ratings (Table 8). This is likely due to the high percentage of samples rated as acceptable during blind testing for each treatment (all > 70%). However, a greater ($P < 0.05$) percentage of Prime samples were rated as acceptable for flavor when brand was disclosed. Additionally, a higher ($P < 0.05$) percentage of Angus Select samples were rated acceptable for flavor and overall when brand was known.

In addition to rating samples for each palatability trait, consumers rated each sample as either unsatisfactory, everyday quality, better than everyday quality, or premium quality (Table 9). In blind testing, consumers classified beef into similar categories as reported in previous studies (Woolley, 2014). However, when brand/grade were disclosed, consumer perception of quality level greatly changed. In blind testing, only 17.4% of Prime samples were classified as "premium" quality, but when grade was disclosed, this number increased ($P < 0.05$) by 18% to more than 35% of Prime samples classified as "premium" quality (Table 10). Conversely, the percentage of Prime samples classified as "everyday quality" decreased ($P < 0.05$) by 13.5%, with no Prime samples classified as "unsatisfactory" when grade was known. A similar trend was observed for CAB® samples. The percentage of CAB® samples classified as "better than everyday quality" increased ($P < 0.05$) by 15.2% and the percentage of CAB® samples classified as "everyday quality" decreased ($P < 0.05$) by almost 20% due to brand identification. For Angus Select samples, the percentage of samples identified as "premium" quality increased ($P < 0.05$) and the percentage of "unsatisfactory" and "everyday quality" samples decreased ($P < 0.05$) due to brand awareness.

Ground Beef Panel

Consumer Demographics, Purchasing Motivators, and Brand Awareness

The demographic profile of consumers who participated in ground beef sensory testing is presented in Table 11. The demographic profile of ground beef consumers was comparable to consumers who participated in steak sensory panels. For ground beef panels, a similar number of males (52.8%) and females (47.2%) participated, with the majority of participants being married (70.4%). Additionally, almost half (47.7%) of panelists were age 30 to 49 and the largest majority (90.8%) Caucasian. 78.9% of panelists reported an annual household income level of greater than $50,000, with 26.6% reporting an income level of over $100,000. More than half (50.5%) of participants were college graduates or had received post-graduate degrees. The

majority (53.6%) of panelists ate beef 4 to 6 times a week. "Flavor" was identified as the palatability trait that was considered most important when eating beef by the large majority (69.7%) of consumers compared to tenderness (21.1%) and juiciness (9.2%). Beef was identified as the meat product with the best flavor by most (58.3%) participants.

Interestingly, 69.7% of consumers in the current study identified "flavor" as the most important beef palatability trait. This number is larger than has been reported in most previous work. Additionally, the percentage of consumers who have identified "flavor" as the most important palatability trait has increased over the past five years. In a study by O'Quinn et al. in 2012, 31.6% of consumers identified flavor as most important in beef steak eating satisfaction. Woolley (2014) reported 44.6% of consumers ranked flavor as most important and, most recently, Corbin et al. (2015) reported 50.8% for the same question. These results, combined with current data, indicate the growing importance of beef flavor to consumers. Conversely, the percentage of consumers who identified "tenderness" as most important has decreased from 58% (O'Quinn, 2012) to the 21.1% observed in the current study. While tenderness remains an important part of beef eating satisfaction, producing beef that will meet consumers' expectations for flavor is equally, and current data would suggest, more important for the beef industry and branded beef programs.

Table 12 presents the beef purchasing motivators of consumers who participated in ground beef sensory panels. Consumers participating in ground beef panels rated the purchasing motivators similar to steak participants, indicating "price" as more important ($P < 0.05$) than all traits other than "size, weight, and thickness". The same product related claims of "steak color", "familiarity with cut", "USDA grade", and "marbling" rated as more important ($P < 0.05$) than all animal production related claims, as was observed with steak panelists. In agreement with current results, previous research has reported nutritional content is of moderate importance and that various animal production traits, including natural and organic claims, were least important to consumers when making beef purchase decisions (Reicks et al., 2011; O'Quinn, 2012).

More than 92% of consumers were familiar with USDA Choice (Table 13), rating higher ($P < 0.05$) than all other brands other than USDA Prime. CAB® was known by more than three-fourths of participants, a higher ($P < 0.05$) percentage than all brands other than USDA Choice and Prime. Angus Pride and Creekstone Farms were the brands recognized by the fewest ($P < 0.05$) consumers. Private Selection Angus was known by a much larger percentage ($P < 0.05$; 60% vs < 34%) of consumers than Angus Pride, Angus Select, Black Canyon Angus Beef, and Creekstone Farms brands.

Consumers rated USDA Prime as higher ($P < 0.05$) quality than all brands other than CAB® and Angus Pride. CAB® was rated as higher ($P < 0.05$) quality than Black Canyon Angus Beef, USDA Choice, Private Selection Angus, and USDA Select. As with steak panels, significant differences varied among the remaining brands, however Choice and Select were

rated numerically lower than all other brands, indicating the perception of higher quality beef with branded products compared to generic USDA grades.

Consumer Taste Panels – Ground Beef

Results from consumer taste panel of ground beef samples are presented in Table 14. Overall, in blind testing, few differences were observed among treatments for all palpability traits evaluated. For tenderness, 90/10 commodity samples rated lower ($P < 0.05$) than all other treatments. No differences ($P > 0.05$) were found in texture liking among all treatments. Both 90/10 treatments (commodity and CAB® ground sirloin) were rated lower ($P < 0.05$) than all other treatments for juiciness. It is worth noting that the average rating for the juiciness of both of these products was less than 50, indicating that consumers classified these samples, on average, as "dry". For overall liking ratings, the only difference that was observed was 80/20 commodity rated higher ($P < 0.05$) than 90/10 commodity samples. No other differences were observed for overall liking among treatments. Additionally, it is noteworthy that the 90/10 commodity treatment rated numerically lowest for all palatability traits, though these lower ratings produced limited statistical differences from other treatments.

It has been well documented that increased fat content in ground beef results in increased flavor, tenderness and juiciness ratings (Cross et al., 1980; Berry and Leddy, 1984; Berry, 1992; Troutt et al., 1992; Berry, 1994). In the current study fat content played some role in consumer palatability perceptions, but the effect was not as strong as reported by previous authors. When comparing treatments blended to similar fat contents, few differences were observed. The only difference observed between 90/10 treatments was 90/10 commodity was tougher ($P < 0.05$) than 90/10 CAB® ground sirloin. Among the three 80/20 blends, the only difference that was observed was the 80/20 CAB® ground chuck rated lower ($P < 0.05$) for flavor liking than both the 80/20 commodity blend and the 80/20 commodity ground chuck blend.

Over the past several years, the National Cattlemen's Beef Association has funded multiple research project evaluating "premium grinds" as a result of increased beef prices and increased consumer demand for ground beef products. Much of this work has focused on primal specific trims (Unruh, 2013), specific muscle sourced trims (Woerner, 2013), fat source location (Kerth et al., 2015), and beef maturity (Bratcher, 2012; Myers et al., 2012). The overwhelming majority of this work has produced results in agreement with our current findings for blind testing. These studies collectively have demonstrated fat percentage plays the largest role in ground beef palatability while both lean and fat source play only minimal, negligible roles when samples are tested blind.

However, in the current study, when products were identified prior to testing, consumer palatability ratings of the products showed large changes (Table 14). Samples from the 90/10 CAB® ground sirloin treatment were rated higher ($P < 0.05$) than all other treatments for

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tenderness, texture, flavor liking and overall liking. The 90/10 CAB® ground sirloin rated higher ($P < 0.05$) than 90/10 commodity product for all traits when the products were known, compared to only tenderness during blind testing. For juiciness, 90/10 commodity rated lower ($P < 0.05$) than all treatments other than 80/20 commodity ground chuck. Among samples with 80% lean, no differences ($P > 0.05$) were observed for all palatability traits.

90/10 CAB® ground sirloin demonstrated very large increases ($P < 0.05$) in palatability ratings for tenderness (17.1%), juiciness (31.7%), flavor liking (16.3%), texture liking (16.3%), and overall liking (21.9%) due to product identification (Table 15). Similarly, CAB® ground chuck increased ($P < 0.05$) 18.0% for flavor liking and 10.1% for overall liking due to brand disclosure. No unbranded products received changes in any palatability trait that could be determined to be different from 0 ($P > 0.05$). However, 90/10 commodity product showed a tendency ($P < 0.10$) to increase in tenderness and juiciness rating and also had increases in flavor, texture and overall liking, though non-significant. This is likely due to the negative stigma surrounding fat content of meat products often believed by consumers. Consumers often associate leaner meats with higher quality products (DeVuyst et al., 2014). Additionally, the Dietary Guidelines for Americans and the nutrition public at-large have encouraged consumers to cut back on dietary fats for the past 30 years. Because of this, many consumers likely viewed the leaner, 90/10 products as "higher quality" or "more healthful" and may have resulted in a more positive evaluation of the product. Conversely, the 73/27 CAB® product did not receive the same "brand lift" that was observed in the other two CAB® products. This could be due in part to the higher fat content of the product. If consumers positively valued leaner products and ranked them accordingly, it would follow suit that higher fat products would be discriminated against. We did not include a commodity 73/27 product in the study for comparison, but there is a possibility that the "brand lift" observed in the two leaner ground beef samples and in the steak samples for CAB® product could be counteracted by the negative consumer perception of the higher fat content product.

Similar trends were observed in consumer acceptability data for ground beef samples (Table 16). When tested blind, no difference ($P < 0.05$) in the percentage of samples rated as acceptable for flavor, texture, or overall like was observed. Additionally, 90/10 commodity had fewer ($P < 0.05$) samples rated acceptable for tenderness than all other treatments. However, when product information was disclosed, 90/10 CAB® ground sirloin had a higher ($P < 0.05$) percentage of samples rated acceptable overall and for tenderness than all other treatments except 80/20 CAB® ground chuck and 73/27 CAB®. Also, 90/10 CAB® ground sirloin had a higher ($P < 0.05$) percentage of samples rated acceptable for flavor than all treatments except 80/20 CAB® ground chuck.

90/10 CAB® ground sirloin had a 20.9% increase ($P < 0.05$) in the number of samples rated acceptable for juiciness, 18.2% for flavor, 18.0% for texture and 13.5% for overall acceptability (Table 17). For 80/20 CAB® ground chuck, 13.0% more ($P < 0.05$) samples were rated acceptable for flavor and 16.2% more overall. Interestingly, 73/27 CAB® received very

little "brand lift" in consumer ratings, however, 11.8% more ($P < 0.05$) samples were rated acceptable overall when the product category was known. The only non-branded product to have a significant change in the percentage of acceptable samples was the 90/10 commodity, which rated 8.3% higher ($P < 0.05$) for tenderness.

Consumer perception of sample quality level is presented in Table 18. During blind testing, few differences were observed in the number of samples classified into each category, with the majority (43 – 50%) of samples from each treatment classified as "everyday quality". However, when products were identified, the percentage of samples perceived to be in each quality level shifted substantially (Table 19). The percentage of 90/10 CAB® ground sirloin samples classified as "better than everyday quality" and "premium quality" increased ($P < 0.05$) by 18.9% and 18.0%, respectively, with a concurrent decrease ($P < 0.05$) in the percentage of "unsatisfactory" (13.5%) and "everyday quality" (23.1%) samples. 80/20 CAB® ground chuck had a 10.8% decrease ($P < 0.05$) in "unsatisfactory" samples and an 11.7% increase in "better than everyday quality" samples due to brand knowledge. Both commodity products received an increase ($P < 0.05$) in the percentage of samples classified as "better than everyday quality", with 90/10 commodity increasing by 13.5% and 80/20 commodity increasing by 14.6% as a result of a 9.1% decrease ($P < 0.05$) in the percentage of "premium quality" classified samples.

Implications and Conclusions

Steak Panel

Consistent with previous work, strip steaks in our study increased in palatability as marbling level increased in blind testing. CAB® and Prime samples in the current study out performed lower grading product, however, when the brand was identified these differences were magnified. During blind testing, CAB® samples were rated similar to lower grading products, specifically Choice samples, however, when informed prior to testing that the samples were CAB®, samples were rated higher than all lower quality grading product for each palatability trait. It is well documented that Prime and CAB® steaks have a palatability advantage, but the results of the current study show that this advantage is amplified when consumers are aware of brands prior to testing.

Interestingly, USDA grade identification for both Choice and Select products had no positive effect on palatability perception. Grade knowledge actually reduced the consumer perception of these samples, specifically in the Choice grade. Conversely, the Angus Select samples increased in palatability ratings for the same reasons. In this study, we attempted to quantify the effect of the "Angus" breed and marketing claim through the use of a generic Angus Select treatment that was presented to consumers with no pictures, only text. Even in this very general, basic form "Angus" had a large effect on consumer perception. Consumers were more

accepting of the palatability level of this product than they were in blind testing due to the perceived quality in the "Angus" brand.

Branding resulted in an overall "brand lift" of 11% for Prime, 10% for CAB®, and 12% for Angus Select samples. The palatability trait that was most responsible for this change was an increase in flavor ratings (12% for Prime; 13% for CAB®; 16% for Angus Select). Changes in tenderness and juiciness perception were only minimal due to brand identification. This indicates delivering a desired, repeatable flavor in beef products offers the greatest opportunity for increasing beef eating satisfaction for any branded beef programs.

Consumers indicated on the pre-trial questionnaire that they associated CAB®, Prime, and most Angus branded products as higher quality than generic Choice and Select grades. These perceptions played a large role in the consumer evaluations of products during non-blind testing. Consumers' perceptions of the product's quality level played a large role in influencing their opinion of the product, with samples from grades they associated as higher quality products rating higher and those with lower quality products lower.

These results give further evidence that brand perception as a "high quality" product to consumers is very important for branded beef programs. Consumers' perceptions of the beef eating experience are strongly influenced by their perceptions and expectations of the beef product they are consuming. The results of the current study indicate that when consumers identify beef products as a certain quality level, they are more likely to perceive that product close to their original bias regardless of the product eating quality they may experience, as was the case with Choice samples in the current study.

Ground Beef Panel

In ground beef testing, some juiciness differences were observed with increased fat content, but overall, when tested blind, few differences were observed among ground beef treatments. Additionally, consumers rated a similar number of samples from each treatment into each of the four quality categories, indicating no perceived advantage of one product over the others. However, when products were identified prior to testing, 90/10 CAB® ground sirloin outperformed all other products for almost every trait evaluated.

90/10 CAB® ground sirloin received an overall "brand lift" of 22% as a result of the large increase in the other palatability traits (17% lift in tenderness; 32% lift in juiciness; 21% lift in flavor; and 16% lift in texture). 80/20 CAB® ground chuck also received an overall "brand lift" of 10% as a result of the 18% lift in flavor rating, again indicating the importance of beef flavor perception. Moreover, the percentage of these two treatments rated acceptable overall increased by 14% for 90/10 CAB® ground sirloin and 16% for CAB® 80/20 ground chuck in addition to a 12% increase in overall acceptability of 73/27 CAB® ground beef.

Consumer panel ratings and acceptability ratings for all commodity products remained relatively unchanged when the products were identified prior to testing. These results indicate that branding of ground beef products is likely as, if not more, important as branding steak items. Consumer perception of ground beef quality was changed drastically when the products were identified with brand information. Unlike whole muscle steak and roast items, ground beef palatability has been shown to remain relatively constant across various blend formulations, muscles, and subprimals when formulated to the same fat percentage. Results of the current study indicate an opportunity for value creation among ground beef items through branding. CAB® branded ground beef items represent a perceived value and quality level to the beef consumer and that value is reflected in their perception of the eating experience.

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Table 1. Carcass characteristics of strip loins used in consumer steak sensory testing

Treatment	Lean Maturity[1]	Skeletal Maturity[1]	Overall Maturity[1]	Marbling Score[2]	Preliminary Fat Thickness, in	Adjusted Fat Thickness, in	Ribeye Area, in²	Hot Carcass Weight, lbs	Kidney, Pelvic, Heart Fat, %	Yield Grade
Prime	158.75	172.50	166.25	776.25[a]	0.61[a]	0.67[a]	13.31[ab]	825.38	2.56	3.57[a]
CAB®	167.50	175.00	172.50	582.50[b]	0.50[ab]	0.58[ab]	12.95[b]	846.50	2.69	3.55[a]
Choice	165.00	157.50	160.00	447.50[c]	0.41[bc]	0.44[bc]	12.93[b]	741.75	2.50	2.80[b]
Select	170.00	165.00	166.25	347.50[d]	0.42[bc]	0.50[abc]	13.84[ab]	781.25	2.69	2.85[b]
Angus Select	170.00	167.50	167.50	355.00[d]	0.33[c]	0.40[c]	14.36[a]	859.38	2.63	2.71[b]
SE[3]	3.18	5.81	3.81	12.63	0.05	0.06	0.37	31.29	0.23	0.22
P - value	0.09	0.26	0.27	< 0.0001	0.012	0.026	0.043	0.067	0.97	0.013

[1]$100 = A^{00}$; $200 = B^{00}$

[2]200: Traces, 300: Slight, 400: Small, 500: Modest, 600: Moderate, 700: Slightly abundant.

[3]SE (largest) of the least squares means.

[abcd]Least squares means in the same column without a common superscript differ ($P < 0.05$).

Table 2. Demographic characteristics of consumers (n = 112) who participated in steak sensory panels.

Characteristic	Response	Percentage of consumers
Sex	Male	42.2
	Female	57.8
Household size	1 person	9.9
	2 people	17.1
	3 people	16.2
	4 people	32.4
	5 people	8.1
	6 people	13.5
	Over 6 people	2.7
Marital Status	Single	33.0
	Married	67.0
Age Group	Under 20	9.0
	20-29	29.0
	30-39	18.2
	40-49	21.8
	50-59	18.2
	Over 60	3.6
Ethnic origin	African-American	15.6
	Asian	0.0
	Caucasian/White	72.5
	Hispanic	10.0
	Native American	1.8
	Other	0.0
Annual household income, $	25,000 to 24,999	14.4
	35,000 to 49,999	8.1
	50,000 to 74,999	23.4
	75,000 to 100,000	27.9
	More than 100,000	26.1
Highest level of education completed	Non-high school graduate	0.0
	High school graduate	9.5
	Some college/technical school	27.6
	College graduate	34.3
	Post graduate	28.6
Weekly beef consumption	1 to 3 times	47.8
	4 to 6 times	46.9
	7 or more times	5.4
Most important palatability trait when eating beef	Flavor	49.6
	Juiciness	9.9
	Tenderness	40.5
Meat product preferred for flavor	Beef	63.1
	Chicken	18.0
	Fish	5.4
	Lamb	0.9
	Mutton	0.0
	Pork	5.4
	Shellfish	3.6
	Turkey	0.0
	Veal	0.9
	Venison	2.7

Table 3. Fresh beef purchasing motivators of consumers (n = 112) who participated in steak consumer sensory panels.

Characteristic	Importance[1]
Price	74.43[a]
Steak color	74.21[a]
Size, weight and thickness	71.32[a]
USDA Grade	63.92[b]
Marbling	62.91[b]
Familiarity of cut	58.66[bc]
Eating satisfaction claims	54.23[cd]
Nutrient content	52.74[cd]
Country of origin	51.59[d]
Animal welfare	49.24[de]
Local	49.05[de]
Antibiotic use in the animal	47.76[def]
Growth promotant use	42.44[ef]
Natural and Organic claims	41.33[f]
Brand of product	40.99[f]
SE[2]	2.51
P - value	< 0.0001

[1]Purchasing Motivators: 0 = extremely unimportant, 100 = extremely important.

[2]SE (largest) of the least squares means.

[abcdef]Least squares means in the same column without a common superscript differ ($P < 0.05$).

Table 4. Knowledge and perceived quality level of beef brands of consumers (n = 112) who participated in steak consumer sensory panels.

Brand	Percentage of Consumers	Perceived Quality Level[1]
Angus Pride	6.25^d	7.86^{abc}
Angus Select	25.89^c	7.45^{bc}
Black Canyon Angus Beef	9.82^d	6.91^{cd}
Certified Angus Beef	83.04^a	8.10^{ab}
Choice	86.49^a	6.39^d
Creekstone Farms	7.21^d	7.13^{bcd}
Prime	80.36^a	8.53^a
Private Selection Angus	66.07^b	7.07^{cd}
Select	79.28^a	6.68^{cd}
SE[2]	0.39	0.59
P - value	< 0.0001	< 0.0001

[1]Perveived Quality Level: 1 = very low quality, 10 = very high quality.

[2]SE (largest) of the least squares means.

[abcd]Least squares means in the same column without a common superscript differ (*P* < 0.05).

Table 5. Consumer (n = 112) palatability ratings[1] for blind and non-blind testing of strip loin steaks.

Treatment	Tenderness	Juiciness	Flavor Liking	Overall Liking
Blind				
Prime	73.50^{ab}	74.12^{ab}	66.84^{bc}	69.24^{b}
CAB®	66.02^{bcd}	57.87^{cd}	63.12^{cde}	64.08^{bc}
Choice	64.82^{ed}	57.83^{cd}	60.63^{efd}	60.86^{cde}
Select	61.92^{ed}	55.64^{d}	55.10^{f}	55.82^{e}
Angus Select	58.48^{ed}	54.55^{d}	55.10^{f}	56.64^{e}
Non-Blind				
Prime	77.75^{a}	68.36^{a}	74.45^{a}	76.41^{a}
CAB®	68.90^{bc}	64.58^{bc}	71.28^{ab}	69.92^{b}
Choice	60.16^{cd}	54.40^{d}	59.97^{ef}	58.67^{cde}
Select	55.75^{e}	56.79^{d}	59.39^{ef}	57.13^{de}
Angus Select	59.26^{ed}	60.70^{cd}	65.81^{bcd}	63.11^{cd}
SE[2]	3.01	2.88	2.12	2.29
P - value	< 0.0001	< 0.0001	< 0.0001	< 0.0001

[1]Sensory scores: 0 = not tender/juicy, dislike flavor/overall extremely; 100 = very tender/juicy, like flavor/overall extremely.

[2]SE (largest) of the least squares means.

Table 6. Percentage of beef strip steaks considered acceptable for tenderness, juiciness, flavor, and overall liking by consumers (n = 112) during blind and non-blind testing.

Treatment	Tenderness Acceptability	Juiciness Acceptability	Flavor Acceptability	Overall Acceptability
Blind				
Prime	98.24[a]	92.74[ab]	87.36[cd]	92.95[b]
CAB®	92.19[abc]	81.38[cd]	90.12[bc]	90.35[b]
Choice	88.59[bcd]	81.38[cd]	83.20[cde]	79.68[cd]
Select	86.69[cde]	75.75[d]	75.03[e]	72.26[d]
Angus Select	76.33[e]	74.89[d]	72.45[e]	70.70[d]
Non-Blind				
Prime	95.63[ab]	98.23[a]	97.59[a]	99.13[a]
CAB®	95.63[ab]	90.20[bc]	95.01[ab]	92.99[b]
Choice	90.44[bc]	75.12[d]	87.55[bcd]	85.92[bc]
Select	79.88[de]	75.80[d]	80.36[de]	78.55[cd]
Angus Select	77.73[e]	77.41[d]	86.56[cd]	80.40[cd]
SE[1]	4.32	4.38	5.71	4.79
P - value	< 0.0001	< 0.0001	< 0.0001	< 0.0001

[1]SE (largest) of the least squares means.

[abcde]Least squares means in the same column lacking a common superscript differ ($P < 0.05$).

Table 7. Change in consumer (n = 112) ratings[1] of palatability traits due to treatment disclosure prior to testing of beef strip loin steaks.

Treatment	Tenderness	Juiciness	Flavor Liking	Overall Liking
Prime	4.12^a	5.18^a	7.71^{a**}	7.37^{a**}
CAB®	3.86^a	5.96^{a*}	8.21^{a**}	5.88^{ab**}
Choice	-4.80^{bc*}	-4.34^b	-0.71^b	-2.03^c
Select	-6.33^{c**}	0.29^{ab}	4.43^{ab*}	1.08^{bc}
Angus Select	0.76^{ab}	5.35^a	8.96^{a**}	6.60^{ab**}
SE[2]	2.56	3.06	2.16	2.11
P - value	0.0017	0.0071	0.0095	0.0056

[1]Sensory scores: 0 = not tender/juicy, dislike flavor/overall extremely; 100 = very tender/juicy, like flavor/overall extremely.

[2]SE (largest) of the least squares means.

abcLeast squares means in the same column lacking a common superscript differ.

*Mean differs from 0 ($P < 0.10$).

**Mean differs from 0 ($P < 0.05$).

Table 8. Change in percentage of beef strip steaks considered acceptable for tenderness, juiciness, flavor, and overall liking by consumers (n = 112) due to treatment disclosure prior to testing.

Treatment	Tenderness Acceptability	Juiciness Acceptability	Flavor Acceptability	Overall Acceptability
Prime	-2.63	5.50	10.90**	6.27
CAB®	3.61	8.95*	5.44	2.63
Choice	1.84	-6.29	4.46	6.20
Select	-6.33	-0.02	4.53	5.40
Angus Select	1.79	3.58	14.43**	9.86**
SE[1]	3.93	4.55	3.95	4.26
P - value	0.3433	0.1411	0.2772	0.8170

[1]SE (largest) of the least squares means.

*Mean differs from 0 ($P < 0.10$).

**Mean differs from 0 ($P < 0.05$).

Table 9. Percentage of beef strip steaks categorized into perceived eating quality levels by consumers (n = 112) during blind and non-blind testing.

Treatment	Unsatisfactory Quality	Everyday Quality	Better than Everyday Quality	Premium Quality
Blind				
Prime	2.60^c	39.69^d	42.17^a	17.43^{bc}
CAB®	4.31^c	54.51^{abc}	27.46^{bc}	12.81^{cb}
Choice	13.04^{ab}	42.90^{cd}	33.71^{ab}	9.34^{cd}
Select	14.80^{ab}	63.44^a	19.45^c	1.67^{de}
Angus Select	18.34^a	47.36^{bcd}	23.01^{bc}	10.20^{cd}
Non-Blind				
Prime	0.00^c	23.23^e	40.87^a	35.21^a
CAB®	3.44^c	34.85^{ed}	42.66^a	18.08^{bc}
Choice	7.78^{bc}	57.19^{ab}	30.14^{ab}	4.20^{de}
Select	14.80^{ab}	53.62^{abc}	26.57^{bc}	1.94^{de}
Angus Select	11.28^{ab}	34.85^{ed}	32.82^{ab}	19.86^b
SE[1]	4.05	4.76	4.91	5.66
P - value	0.0017	< 0.0001	0.0011	< 0.0001

[1]SE (largest) of the least squares means.

^{abcde}Least squares means in the same column lacking a common superscript differ ($P < 0.05$).

Table 10. Change in percentage of beef strip steaks categorized into perceived eating quality levels by consumers (n = 112) due to treatment disclosure prior to testing.

Treatment	Unsatisfactory Quality	Everyday Quality	Better than Everyday Quality	Premium Quality
Prime	-2.70	-13.51[b]**	-1.80	18.01[a]**
CAB®	3.48	-19.64[b]**	15.18**	5.36[bc]
Choice	-5.36	14.29[a]**	-3.57	-5.36[c]
Low Select	0.00	-9.82[b]	7.14	2.68[bc]
Angus Select	-7.14**	-12.50[b]**	9.82	9.82[ab]**
SE[1]	3.49	6.17	6.16	4.04
P - value	0.5619	0.0013	0.1577	0.0012

[1]SE (largest) of the least squares means.

[abc]Least squares means in the same column lacking a common superscript differ.

*Mean differs from 0 ($P < 0.10$).

**Mean differs from 0 ($P < 0.05$).

Table 11. Demographic characteristics of consumers (n = 112) who participated in ground beef sensory panels.

Characteristic	Response	Percentage of consumers
Sex	Male	52.8
	Female	47.2
Household size	1 person	9.9
	2 people	31.5
	3 people	17.1
	4 people	19.8
	5 people	13.5
	6 people	1.8
	Over 6 people	6.3
Marital Status	Single	29.6
	Married	70.4
Age Group	Under 20	9.2
	20-29	18.4
	30-39	25.7
	40-49	22.0
	50-59	15.6
	Over 60	9.2
Ethnic origin	African-American	1.8
	Asian	3.7
	Caucasian/White	90.8
	Hispanic	3.7
	Native American	0.0
	Other	0.0
Annual household income, $	25,000 to 24,999	11.0
	35,000 to 49,999	10.1
	50,000 to 74,999	25.7
	75,000 to 100,000	26.6
	More than 100,000	26.6
Highest level of education completed	Non-high school graduate	5.6
	High school graduate	9.4
	Some college/technical school	34.6
	College graduate	29.0
	Post graduate	21.5
Weekly beef consumption	1 to 3 times	42.7
	4 to 6 times	53.6
	7 or more times	3.6
Most important palatability trait when eating beef	Flavor	69.7
	Juiciness	9.2
	Tenderness	21.1
Meat product preferred for flavor	Beef	58.3
	Chicken	14.8
	Fish	0.9
	Lamb	6.5
	Mutton	0.0
	Pork	9.3
	Shellfish	5.6
	Turkey	2.8
	Veal	0.0
	Venison	1.9

Table 12. Fresh beef purchasing motivators of consumers (n = 112) who participated in ground beef consumer sensory panels.

Characteristic	Importance[1]
Price	73.79[a]
Size, weight and thickness	68.55[ab]
Steak color	67.02[bc]
Familiarity of cut	62.22[bcd]
USDA grade	62.05[bcd]
Marbling	60.81[cd]
Nutrient content	55.54[d]
Country of origin	48.43[e]
Local	46.14[e]
Eating satisfaction claims	46.00[e]
Animal welfare	43.54[ef]
Antibiotic use in the animal	43.32[ef]
Brand of product	42.63[efg]
Growth promotant use	37.91[fg]
Natural and Organic claims	36.32[g]
SE[2]	2.42
P – value	< 0.0001

[1]Purchasing Motivators: 0 = extremely unimportant, 100 = extremely important.

[2]SE (largest) of the least squares means.

[abcdefg]Least squares means in the same column without a common superscript differ ($P < 0.05$).

Table 13. Knowledge and perceived quality level of beef brands of consumers (n = 112) who participated in ground beef consumer sensory panels.

Brand	Percentage of Consumers	Perceived Quality Level[1]
Angus Pride	12.15^e	7.23^{abc}
Angus Select	33.03^d	7.00^{bc}
Black Canyon Angus Beef	23.36^d	6.80^c
Certified Angus Beef	77.06^b	7.59^{ab}
Choice	92.79^a	6.77^c
Creekstone Farms	10.28^e	6.91^{bc}
Prime	86.36^{ab}	8.14^a
Private Selection Angus	60.00^c	6.91^c
Select	82.57^b	6.34^c
SE[2]	0.36	0.51
P - value	< 0.0001	< 0.0001

[1]Perveived Quality Level: 1 = very low quality, 10 = very high quality.

[2]SE (largest) of the least squares means.

[abcde]Least squares means in the same column without a common superscript differ ($P < 0.05$).

Table 14. Consumer (n = 112) palatability ratings[1] for blind and non-blind testing of ground beef patties of different fat percentages, brands, and primal sources.

Treatment	Tenderness	Juiciness	Flavor Liking	Texture Liking	Overall Liking
Blind					
90/10 commodity	52.06^d	45.93^e	57.15^{cd}	55.34^b	55.67^c
90/10 CAB® ground sirloin	60.91^{bc}	47.43^e	59.77^{bcd}	60.03^b	59.27^{bc}
80/20 commodity	61.84^{bc}	58.59^{abc}	60.79^{bc}	59.24^b	61.65^b
80/20 commodity ground chuck	61.60^{bc}	55.19^{bcd}	61.16^{bc}	58.62^b	59.49^{bc}
80/20 CAB® ground chuck	58.52^{bc}	52.66^{cde}	53.96^d	57.36^b	56.96^{bc}
73/27 CAB®	62.19^{bc}	57.13^{abcd}	57.28^{cd}	56.46^b	58.80^{bc}
Non-Blind					
90/10 commodity	56.99^{cd}	51.57^{de}	60.68^{bc}	57.67^b	59.35^{bc}
90/10 CAB® ground sirloin	71.12^a	61.96^{ab}	72.43^a	69.72^a	72.19^a
80/20 commodity	61.28^{bc}	62.18^a	61.55^{bc}	58.49^b	61.55^b
80/20 commodity ground chuck	60.03^{bc}	56.77^{abcd}	58.83^{bcd}	57.91^b	59.77^{bc}
80/20 CAB® ground chuck	61.59^{bc}	58.70^{abc}	63.67^b	60.14^b	62.73^b
73/27 CAB®	64.07^b	62.35^a	59.32^{bcd}	59.68^b	59.69^{bc}
SE[2]	2.23	2.54	2.47	2.01	2.24
P - value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

[1]Sensory scores: 0 = not tender/juicy, dislike flavor/texture/overall extremely; 100 = very tender/juicy, like flavor/texture/overall extremely.

[2]SE (largest) of the least squares means.

[abcde]Least squares means in the same column lacking a common superscript differ (*P* < 0.05).

Table 15. Change in consumer (n = 112) palatability ratings[1] of ground beef patties of different fat percentages, brands, and primal sources due to treatment disclosure prior to testing.

Treatment	Tenderness	Juiciness	Flavor Liking	Texture Liking	Overall Liking
90/10 commodity	4.96[ab]*	5.86[b]*	3.48[bc]	2.34[b]	3.72[b]
90/10 CAB® ground sirloin	10.43[a]**	15.04[a]**	12.51[a]**	9.79[a]**	12.99[a]**
80/20 commodity	0.03[bc]	4.52[b]	0.99[c]	-0.51[b]	0.10[b]
80/20 commodity ground chuck	-1.47[c]	1.88[b]	-1.85[c]	-0.59[b]	-0.03[b]
80/20 CAB® ground chuck	3.27[bc]	6.80[b]*	9.73[ab]**	3.16[b]	5.78[b]**
73/27 CAB®	1.80[bc]	5.76[b]*	2.04[c]	3.04[b]	0.81[b]
SE[2]	2.47	3.28	2.60	2.21	2.37
P - value	0.0035	0.0067	< 0.0001	0.0078	0.0002

[1]Sensory scores: 0 = not tender/juicy, dislike flavor/texture/overall extremely; 100 = very tender/juicy, like flavor/texture/overall extremely.

[2]SE (largest) of the least squares means.

[abc]Least squares means in the same column lacking a common superscript differ.

*Mean differs from 0 ($P < 0.10$).

**Mean differs from 0 ($P < 0.05$).

Table 16. Percentage of ground beef samples considered acceptable for tenderness, juiciness, flavor, and overall liking by consumers (n = 112) during blind and non-blind testing.

Treatment	Tenderness Acceptability	Juiciness Acceptability	Flavor Acceptability	Texture Acceptability	Overall Acceptability
Blind					
90/10 commodity	73.42[d]	63.09[d]	76.00[bc]	80.87[cd]	74.30[d]
90/10 CAB® ground sirloin	87.77[bc]	63.09[d]	77.72[bc]	79.99[d]	81.58[bcd]
80/20 commodity	86.88[bc]	78.55[bc]	83.34[bc]	81.75[cd]	83.23[bcd]
80/20 commodity ground chuck	90.23[abc]	77.27[bc]	82.26[bc]	86.46[bcd]	79.56[cd]
80/20 CAB® ground chuck	85.83[bc]	68.91[cd]	72.62[c]	82.20[cd]	72.09[d]
73/27 CAB®	85.99[bc]	80.36[bc]	79.85[bc]	85.22[bcd]	77.95[cd]
Non-Blind					
90/10 commodity	82.28[cd]	64.93[d]	80.73[bc]	82.75[cd]	81.47[bcd]
90/10 CAB® ground sirloin	95.70[a]	83.21[ab]	94.07[a]	96.87[a]	94.89[a]
80/20 commodity	86.87[bc]	83.99[ab]	82.56[bc]	82.61[cd]	82.5[bcd]
80/20 commodity ground chuck	87.73[bc]	77.64[bc]	84.20[b]	84.3[cd]	86.92[bc]
80/20 CAB® ground chuck	89.61[abc]	79.63[bc]	86.10[ab]	89.54[bc]	87.93[abc]
73/27 CAB®	93.92[ab]	90.22[a]	83.26[bc]	92.8[ab]	89.54[ab]
SE[1]	4.74	5.02	5.20	4.81	5.19
P - value	0.0015	< 0.0001	0.0298	0.0139	0.0012

[1]SE (largest) of the least squares means.
[abcd]Least squares means in the same column lacking a common superscript differ ($P < 0.05$).

Table 17. Change in percentage of ground beef patties considered acceptable for tenderness, juiciness, flavor, texture and overall liking by consumers (n = 112) due to treatment disclosure prior to testing..

Treatment	Tenderness Acceptability	Juiciness Acceptability	Flavor Acceptability	Texture Acceptability	Overall Acceptability
90/10 commodity	8.26**	1.97	5.55[abc]	1.80[b]	6.36
90/10 CAB® ground sirloin	8.11*	20.86**	18.23[a]**	18.02[a]**	13.51**
80/20 commodity	0.00	5.55*	-1.82[c]	0.91[b]	-0.92
80/20 commodity ground chuck	-2.75	0.13	1.87[bc]	-2.78[b]	7.27
80/20 CAB® ground chuck	4.50	11.01**	13.00[ab]**	8.18[ab]*	16.22**
73/27 CAB®	8.11*	10.05*	2.77[bc]	8.11[ab]*	11.82**
SE[1]	4.18	5.49	4.84	4.37	4.62
P - value	0.2608	0.0546	0.0255	0.0126	0.1147

[1]SE (largest) of the least squares means.

[abc]Least squares means in the same column lacking a common superscript differ.

*Mean differs from 0 ($P < 0.10$).

**Mean differs from 0 ($P < 0.05$).

Table 18. Percentage of ground beef patties of varying quality treatments categorized into perceived eating quality levels by consumers (n = 112) during blind and non-blind testing.

Treatment	Unsatisfactory Quality	Everyday Quality	Better than Everyday Quality	Premium Quality
Blind				
90/10 commodity	19.90[a]	50.31[a]	22.73[cd]	5.98[c]
90/10 CAB® ground sirloin	16.27[ab]	45.75[a]	32.73[bc]	4.45[c]
80/20 commodity	14.45[ab]	49.40[a]	20.00[d]	13.86[ab]
80/20 commodity ground chuck	16.43[ab]	43.40[a]	32.11[bc]	6.78[bc]
80/20 CAB® ground chuck	20.11[a]	47.98[a]	22.94[cd]	7.58[bc]
73/27 CAB®	14.45[ab]	46.66[a]	31.85[bc]	5.98[c]
Non-Blind				
90/10 commodity	17.04[ab]	39.87[a]	36.94[b]	5.17[c]
90/10 CAB® ground sirloin	2.68[c]	22.64[b]	51.35[a]	20.30[a]
80/20 commodity	9.02[bc]	49.36[a]	34.55[bc]	6.00[c]
80/20 commodity ground chuck	10.85[ab]	49.37[a]	34.55[bc]	4.44[c]
80/20 CAB® ground chuck	9.84[b]	46.21[a]	34.23[bc]	8.22[bc]
73/27 CAB®	9.02[bc]	53.01[a]	29.09[bcd]	7.53[bc]
SE[1]	3.99	4.99	4.74	5.64
P - value	0.0155	0.0043	0.0004	0.0006

[1]SE (largest) of the least squares means.

[abcde]Least squares means in the same column lacking a common superscript differ ($P < 0.05$).

Table 19. Change in percentage of ground beef patties categorized into perceived eating quality levels by consumers (n=112) due to treatment disclosure prior to testing.

Treatment	Unsatisfactory Quality	Everyday Quality	Better than Everyday Quality	Premium Quality
90/10 commodity	-2.70	-9.58^{bc}	13.51**	-0.90^{b}
90/10 CAB® ground sirloin	-13.51**	-23.09^{c}**	18.92**	18.02^{a}**
80/20 commodity	-4.55	-0.56^{ab}	14.55**	-9.09^{b}**
80/20 commodity ground chuck	-5.45	7.62^{a}	0.91	-2.73^{b}
80/20 CAB® ground chuck	-10.81**	-1.47^{ab}	11.71**	0.90^{b}
73/27 CAB®	-5.41	6.64^{ab}	-1.80^{b}	0.90^{b}
SE[1]	4.22	6.45	5.90	3.67
P - value	0.4298	0.0038	0.0849	< 0.0001

[1]SE (largest) of the least squares means.

^{abc}Least squares means in the same column lacking a common superscript differ.

*Mean differs from 0 ($P < 0.10$).

**Mean differs from 0 ($P < 0.05$).