Impact of providing information about the fat content, primal source, price, and labeling terms on consumer sensory evaluation of ground beef from the same source

by

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Abstract

The objective of these studies was to evaluate the effect of supplying information about the fat content, primal source, price, and branding information prior to consumers sensory evaluation of ground beef from an identical source. Ground beef (80% lean / 20% fat) chubs (n = 30) were procured from the same production lot and day and manufactured into 151.2 g patties. Each chub was randomly assigned to two panels for one of the four different treatment categories: fat content, primal source, price, or branding. Samples designated for fat panels were labeled as: 90% lean / 10% fat (90/10), 80% lean / 20% fat (80/20), 73% lean / 27% fat (73/27), lean, and extra lean. Primal source samples were labeled as: ground chuck, ground round, ground sirloin, and store ground. Samples designated for price panels were labeled with one of five different price points: ultra-high, high, medium, low, and ultra-low. Labeling terms utilized and randomly labeled for branding panels: all natural, animal raised without added antibiotics (WA), animal raised without added hormones (WH), fresh never frozen (FNF), grass-fed, locally sourced, premium quality, and USDA organic (ORG). An additional sample for each panel had no information provided (NONE). Samples were fed to consumers (N = 420; 105 / panel type) who evaluated each sample on 0-to-100-point line scales for tenderness, juiciness, flavor, texture, overall liking, and purchasing intent, and evaluated each trait as either acceptable or unacceptable. Ground beef labeled as 90/10, 80/20, and 73/27 had a large increase ($P < 0.05$) in consumer ratings for tenderness, flavor, and overall liking when the treatment was disclosed to consumers. When consumers were informed of the price of the product, large increases ($P < 0.05$) were observed for all palatability traits on samples that were priced at the ultra-high, high, medium, and ultra-low-price points. Additionally, when the primal blend type was disclosed, there was a large increase ($P < 0.05$) for all palatability traits evaluated for all four primal blend

treatments. Informing consumers about the price and primal blend increased ($P < 0.05$) the purchasing intent ratings for all price and primal blend treatments. For flavor liking, there was a larger increase ($P < 0.05$) in ratings for samples labeled as grass-fed in comparison to WA, WH, and premium quality labeled samples. There was a large increase ($P < 0.05$) in the consumer ratings for overall liking when product was labeled as all natural, WA, WH, FNF, locally sourced, premium quality, and ORG. Additionally, there was a larger decrease ($P < 0.05$) in the percentage of samples rated as acceptable overall when labeled as WA in comparison to all other treatments. Ultimately, adding production claims that consumers are familiar with gives a "brand lift" to ground beef. Furthermore, consumers are impacted both negatively and positively impacted in their eating experience when they are aware of the fat content, primal source, and price of ground beef.

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Dedication

This thesis is dedicated to all the friends and family across the country who have provided endless support and love, much needed phone conversations, cow fixes, and adventures when needed.

Chapter 1 - Literature Review

Ground Beef

Ground beef is one of the most widely consumed, yet understudied beef products available to consumers around the globe. Ground beef is defined as being of skeletal origin from the beef animal, under 30% fat and processed to only include grinding of the skeletal tissue (USDA-FSIS, 2010). In 2020, ground beef consumption was estimated to be around 27 pounds per capita in the U.S. and accounted for over 46% of the total U.S. retail beef consumed (Schulz, 2021). In the U.S., much of the ground beef originates from three primary sources: fed cattle, mature cattle, and/or imported lean (Speer et al., 2015). Moreover, ground beef comprises approximately 49% of retail sales volume and 39% of retails revenue (Speer et al., 2015). Much of the recent research has focused on using different primal sources and production systems, while previous research done in the late 20th century was focused on fat and lean content. The most recent ground beef research has focused on the impact of branding and production system differences that can have an impact on the consumers perceived palatability of the product.

Effect of Primal Source on Ground Beef

Most recently, in an effort to find "premium blend" concepts several studies have looked at the impact of primal sources on the palatability of ground beef in blind studies. To better understand the relationship between trained and consumer panelist ratings for ground beef, Beavers (2017) utilized 16 different treatments that included four meat block sources that included chuck, regular (commodity), sirloin and round, as well as two different fat percentages of 10 and 20%. Texture liking was affected by both primal source and fat content in the consumer portion of the study, where consumers rated regular ground beef and 10% fat ground beef as being more desirable for texture. Moreover, consumers preferred the flavor of round,

sirloin, and regular commodity product over that of chuck. Additionally, in both the consumer and trained sensory panels there was a significant interaction between the meat source and fat content for the beef identity flavor and the consumers flavor liking. Similarly, Kerth et al. (2015) utilized fat trimmings from the brisket, chuck, plate, flank, and round to formulate 20% fat ground beef patties from a single source of lean. Consumers in that study found no differences for all palatability traits evaluated among the five different fat sources. Since no differences were found, Kerth et al. (2015) concluded that the primary impact on flavor was found in the phospholipid fraction of the fat tissue and not in the triglyceride portion which the study was using as their fat source. Alternatively, Blackmon et al. (2015) found differences in a trained panel setting when looking at flavor descriptors and off flavors in ground beef patties formulated to 10, 20 and 30% fat from the brisket, flank, and plate. Patties formulated from the brisket and flank had higher ratings for bloody/serumy than those from the plate. Additionally, brisket and plate formulated patties had greater fat-like flavor than those formulated from the flank. Blackmon et al. (2015) concluded that utilizing brisket in ground beef formulations provided a distinct flavor and composition. When evaluating ground beef from 7 different muscle source treatments in a trained sensory panel, ground beef from tenderloins were rated as more tender than formulations that included shoulder clods, knuckles, sirloin caps and 81/19 trim (McHenry, 2013). Additionally, tenderloin samples were perceived by the panelists to have the smallest particle size, while also having the lowest ratings for beefy/brothy, buttery/beef fat and browned/grilled flavor (McHenry, 2013). Moreover, the same panel found ground beef from sirloin caps to be juicier than that sourced from shoulder clods, short ribs, brisket, knuckles, and tenderloins, but similar to ground beef made with 81/19 chuck trim (McHenry, 2013).

Ultimately, the “premium blend” concept presents conflicting results when evaluating the palatability of the various sources.

While most source blend concepts have looked at specific primal sources, a few studies have looked at the impact of USDA quality grades. Myers (2012) utilized 95% lean blends from Top Choice (Modest and Moderate marbling), cow (USDA Utility) and commercial (A-maturity, Small or Slight marbling) sources in a trained sensory setting. Patties from the Top Choice treatment group had a firmer rating for texture when compared to the cow and commercial treatments. There were no differences in the flavor, juiciness, off-flavor, and greasiness in the trained sensory analysis among the quality grade treatments. Additionally, there were no differences among the quality grade treatment groups found in the consumer sensory portion of the study utilizing the same grind concepts. Myers (2012) concluded that utilizing older cow meat had a marginal impact on the sensory palatability of ground beef by both trained and consumer panelists. These results were similar to those found by Berry and Abraham (1996) when looking at ground beef patties formulated from young cattle (less than 24 months) and old, cow beef (greater than 24 months of age). Patties formulated from young cattle was more tender and had less connective tissue when evaluated by a sensory panel in comparison to the ground beef patties from old beef.

The earliest research looking at primal source blends exists from Cross et al. (1976) in which chucks and short plates from five USDA quality grades were utilized along with a blend that combined the two sources. A trained panel evaluated the tenderness, juiciness, flavor, connective tissue, and overall acceptability. When solely evaluating the cut, chuck formulated patties had the highest ratings for tenderness, flavor, connective tissue amount, and overall acceptability when compared to both the plate and combination treatments. Moreover, when

evaluating the cut and quality grade combinations utilizing the combination treatment did not make up for the decline in eating quality at lower quality grades (Cross et al., 1976). More recently, Highfill (2012) utilized chuck rolls and knuckles from Premium Choice (Modest and Moderate marbling) and Select carcasses to determine the effect of quality grade and aging time on ground beef sensory traits in a trained panel format. Ground beef from the Premium Choice chuck rolls were firmer and had more mouth coat than the Select chuck rolls, however, quality grade did not have an effect on the ground beef made from the knuckle (Highfill, 2012). Also, aging time, which ranged from 7 to 42 days, did not have an effect on the panels perceived palatability of the product that was evaluated (Highfill, 2012). These results differ significantly from what we typically find in beef cuts, where USDA quality grade is directly related to the eating quality of the cut being evaluated (O'Quinn et al., 2012; Legako et al., 2015; O'Quinn et al., 2018).

When evaluating the effect of primal and source blends, there are conflicting results from a trained panel perspective. With the limited data available, however, consumers show no preference in the source of ground beef (Myers, 2012; Beavers, 2017). Furthermore, in an actual purchasing setting Ward et al. (2008) in a sampling of various metropolitan supermarket scanner data, found ground chuck to be priced higher and purchased more frequently than commodity product. This indicates that consumers are willing to pay a premium for source grinds that they perceive to higher quality.

Effect of Fat Content on Ground Beef

When some of the first research was published in regard to ground beef, little was understood about the palatability and effect of various grades, fat content, and cuts. Fruin and Van Duyne (1961) evaluated the effect of grade (U.S. Commercial or Standard), cut (chuck or

round), and whether the cut was trimmed or untrimmed and had trained judges evaluate the patties. When evaluating the cut, the fat percentages of the chuck were measured to be higher than the round and accordingly the judges preferred the chuck patties overall over the round patties. Additionally, the chuck was rated higher for juiciness than the round, however, grade and trim type did not have a significant effect on the palatability of the ground beef (Fruin and Van Duyne, 1961). After this work conducted in the early 60's, Law et al. (1965) followed up with a consumer sensory analysis of families who purchased frozen patties and bulk ground beef of 15, 25, or 35% fat. When combining the pooled results from both the ground beef and patties, the 35% fat formulation had the highest general (overall) rating, and the highest ratings for juiciness and flavor in comparison to 15 and 25% fat. While little was known prior to these two studies on the palatability of ground beef and the effect of fat content, this set the platform for future work to be done when fat content in food products became a worldwide issue in the 1980's.

Much of the published research regarding the impact of fat content on the palatability of ground beef came about in the 1980s and late 90s due to the health craze surrounding the fat content of commonly consumed food products. Most recently, Wong and Maga (1995) studied ground beef of 4, 12, 20, or 30% fat and fed patties that were cooked to a medium degree of doneness to a trained panel. As fat level increased so did the perceived juiciness of the patties, however, panelists did rate 12% and 20% fat patties as being similar for juiciness. Wong and Maga (1995) cited the lubrication theory in which fat acts as a means of lubrication and ultimately sustained juiciness. Additionally, the same trend was exhibited when panelists evaluated the texture and tenderness of the ground beef patties. Within the same study, no differences were found for aroma, flavor, and overall eating quality. The authors ultimately concluded that tenderness and juiciness were not major contributors to the overall acceptability

of the product (Wong and Maga, 1995). Similarly, Troutt et al. (1992) utilized 5, 10, 15, 20, 25, and 30% fat ground beef patties and evaluated them in a trained panel setting at two different endpoint temperatures. As fat content increased, so did the initial and sustained juiciness of the patties. The textural properties of the patties also changed significantly when comparing 5 and 10% fat patties to the 20 and 30% fat patties. The patties from the 5 and 10% treatments had a firmer and more cohesive mouth feel, which the authors concluded need to be improved for the palatability to be similar to 20 and 30% fat formulations. Taking a different approach to decreasing the fat content in patties, Miller et al. (1993) evaluated 10 or 22% fat ground beef patties with the addition of water or added phosphate in a trained panel setting and cooked to 70°C. When evaluating juiciness, patties formulated to 10% fat and without the addition of added water had a decrease in juiciness ratings when compared to the higher fat and water added formulations. Tenderness and texture differences were also found and followed the same finding as the juiciness results where the added fat and water allowed for the patties to be more tender. More recently, Garzon et al. (2003) found 20% fat ground beef to be more tender and juicier when compared to 10% fat ground beef in a trained panel setting. Ultimately, fat content has an impact on the juiciness and tenderness of cooked ground beef. However, within the published literature there is little evidence that increasing or decreasing fat content has an overall effect on decreasing the perceived palatability of the ground beef by consumers.

Cooking ground beef to differing degrees of doneness has been tested to see if cooking to lower temperatures will overcome the reduction in juiciness due to the decrease in fat content. When decreasing fat from 20% to 4% in ground beef patties, Berry (1994) found reduced tenderness scores in a trained panel setting as the fat content decreased. Additionally, when cooked to differing degrees of doneness the added fat content in the 20% fat patties allowed for

stronger beef flavor intensity when cooked to medium and well-done in comparison to the 4% formulation cooked to the same degree of doneness. In the same study, they also utilized Inston shear force testing and found that as the fat content decreased from 20% to 4% the values for cohesiveness, gumminess, and chewiness increased for the lower fat content ground beef patties. Ultimately, Berry (1994) concluded that when cooking to a medium degree of doneness, 4% fat patties could replicate the tenderness and juiciness values of 20% fat patties cooked to well-done. Similarly, Kregel et al. (1986) arrived at the same conclusions when cooking ground beef patties of 9.5, 21.1 and 28.5% fat to 71°C or 77°C. Once again, fat content was linearly related to juiciness and tenderness, but inversely related to connective tissue amount in the trained sensory panel. Additionally, as the cooked temperature increased from 71 to 77°C, the panelists perceived juiciness and tenderness of the patties decreased as the temperature increased (Kregel et al., 1986).

While they did not feed ground beef to consumers, Lusk and Parker (2009) choose to investigate the amount and type of fat that was preferred by consumers in choice-based conjoint analysis. Consumers placed more significant value on saturated fat and the Omega 6:3 ratio, however, total fat content is the only thing found on current ground beef labeling. Additionally, consumers were willing to pay more for lower fat, lower saturated fat ground beef than lower fat, higher saturated fat ground beef. Modern day consumers place more emphasis on what types of fat they are consuming, while also still being concerned over how much fat they are consuming, thus driving the market for lower fat ground beef products. Additionally, Speer et al. (2015) reported that 70-77% lean ground beef is the most popular ground beef sold at retail followed by 78-84% lean, 90-95% lean, 85-89% lean, and less than 95% lean. More recently, 70-77% lean

ground beef accounted for the biggest percentage of sales and pounds sold amongst all ground beef sold, further indicating the popularity of higher fat ground beef products (Checkoff, 2019).

Production Practice Effects

Limited studies have looked at the effect of production practices on the palatability of ground beef. Most recently, Najar-Villarreal et al. (2019) looked at 80/20 ground beef from grass-fed and Angus production systems in comparison to commodity ground beef. No differences were found between the three different treatments for the tenderness, juiciness, flavor liking, and texture liking palatability ratings when fed in a blind consumer panel. Consumers rated grass-fed as the lowest for overall liking in comparison to Angus and commodity ground beef. Moreover, Angus ground beef had a higher percentage of consumers who rated it as acceptable overall in comparison to grass-fed, with commodity ground beef being similar to both Angus and grass-fed ground beef. Najar-Villarreal et al. (2019) contributed these results to the different fatty acid composition that was present in grass-fed beef, which is known to alter the palatability characteristics of grass-fed in comparison to grain-fed beef. In conclusion, Najar-Villarreal et al. (2019) cited consumers were willing to pay a premium of $0.86 ± $0.49 to purchase grass-fed labeled products that are rich in omega-3. Previously, Melton et al. (1982) looked at the effect of the length of corn feeding on the flavor and composition of ground beef. When evaluating beef flavor, the trained panel found that as the days on corn feeding increased so did the desirable beef-fat flavor.

Branding

Consumers utilize numerous extrinsic and intrinsic cues when purchasing and evaluating products at retail. Cues are relayed via the information communicated in brands, which assist in the quality expectations set when food is bought by the consumer (Steenkamp and vanTrijp,

1996). Branding strategies have been shown to affect the perceived eating quality of food products (Dodds et al., 1991). The purchasing consumer considers mostly extrinsic cues which differ based on the type of meat (Aboah and Lees, 2020). Claims and cues found on the products interact to increase the credibility of the product, which the consumer ultimately uses when tasting and eating (Bailey and Muldrow, 2019). Cox (1962) reported two factors that affect the perceived applicability of quality cue to the consumer: the predictive value or how the cue is related to product quality, and the confidence value or the consumers' confidence in their ability to interpret or use the cue. Therefore, using ques that are more familiar to the consumer and related to product quality will resonate more with the consumer and make them more likely to buy a product.

In the case of meat products, the main form of communication comes from cues found at the time of purchase (Nocella et al., 2010). Advertising of the brand plays an important role in affecting the consumers preference for products, especially when it increases the consumers knowledge of the product (Skipper et al., 1999). The ability to tell the story of a product through the appeal of attributes that are more natural or authentic, help to increase consumer interest (Fenger et al., 2015). When consumers purchase a product, they evaluate both the product quality and their individual preferences on taste, in hand with their financial capabilities (Mueller and Szolnoki, 2010). While taste is the strongest attribute for determining the consumers preference, price and brand packaging also strongly affect the consumers eating experience (Méndez et al., 2011). Older more experienced consumers rely more heavily on extrinsic cues in the form of packaging and branding (Mueller and Szolnoki, 2010). The combination of extrinsic and intrinsic cues that consumers use to predict and assess beef quality varies widely among consumers and their particular uses of the product (McIlveen and Buchanan, 2001). Bredahl (2003) found

consumers who have a low familiarity with a product tend to focus more heavily on the brand of the product as a quality cue. With meat, the extrinsic cues that consumers mainly focus on are attributes about animal feeding, animal origination, environmental friendliness, and animal welfare (Bernués et al., 2003).

When evaluating known and unknown drill brands, Germann et al. (2020) found a strong influence with the well-known brands and a negative influence on the unknown drill brands. Upon testing the drills out, many in the study changed their perceptions of the unknown brands, however, most indicated that due to the brand they would still be unwilling to purchase the drill. Moreover, consumers who have previously purchased branded products generally have a better perception of the product and accordingly are willing to spend a premium on products (Wachenheim et al., 2000).

Ground Beef Branding

Limited studies exist as to how the effect of branding plays into consumers perceptions of ground beef. Of the published research few studies have looked at product in a retail case setting and then evaluated the same product for palatability. Pohlman (2017) evaluated ground beef from 4-27% fat in a retail case setting where packages were both labeled and unlabeled, and then followed up with the same set of untrained consumers in a tasting panel to evaluate the same product in a blind setting. In the retail case portion, consumers preferred the 20% fat product when a label was attached and unattached to the product, while the 27% fat product was preferred the least (Pohlman, 2017). Consumers in this study did identify fat, price, and color as being the most important characteristics when selecting ground beef, however, the study did not look at other visual preference cues aside from overall preference in the retail case portion. No differences were found for juiciness, bind, beef flavor, off flavor, and overall impression in the

tasting portion in which the same ground beef was used from the retail case setting (Pohlman, 2017). While the consumer portion of this study differs from previous research that has found differences in tenderness and juiciness as fat content increases, it demonstrated that consumers do have a visual preference for fat content when looking at product in the retail display as they are purchasing.

Only one published study to date has evaluated the change in consumers perceptions when given additional information about the product versus when none is provided. When evaluating the effect of brand and product identification in blind and informed testing, Wilfong et al. (2016a) found consumer palatability ratings to increase for multiple traits across different fat levels, brands, and primal sources of ground beef. The treatments in the study included: 90/10 ground beef, 90/10 Certified Angus Beef (CAB) ground sirloin, 80/20 ground beef, 80/20 ground chuck, 80/20 CAB ground chuck, and 73/27 CAB ground chuck. During the blind testing portion, fat level affected juiciness with the 3 higher fat formulations consisting of 80/20 ground beef, 80/20 ground chuck, and 73/27 CAB ground beef rating higher than the two 90/10 formulations (Wilfong et al., 2016a). No differences were found in the blind portion for flavor liking, texture liking and overall liking in the blind testing portion, however, upon supplying the consumers with the information about each of the samples pertaining to the fat content, brand, and primal source, the consumers perceptions changed (Wilfong et al., 2016a). For the informed testing portion, consumers ranked 90/10 CAB ground sirloin the highest for flavor liking, texture liking and overall linking when compared to all other treatments (Wilfong et al., 2016a). Additionally, consumers ranked commodity 90/10 ground beef as the lowest for juiciness and tenderness during the informed portion of the study (Wilfong et al., 2016a). When consumers were informed about the product they were consuming, overall liking scores increased the most

for 90/10 CAB ground sirloin samples when compared to 90/10 ground beef, 80/20 ground beef, 80/20 ground chuck, 80/20 CAB ground chuck, and 73/27 CAB ground beef (Wilfong et al., 2016a). Additionally, the tenderness, juiciness, texture liking, and flavor liking scores also increased substantially when the treatment information was disclosed for 90/10 CAB ground sirloin (Wilfong et al., 2016a). The non-CAB branded products had decreases or minimal improvements in the consumer ratings when the product information was disclosed to the consumers, indicating the importance of attaching additional information to the labels of beef products (Wilfong et al., 2016a). In conclusion, decreasing the fat content and adding in CAB related branding had an impact on the consumers perceived palatability of ground beef. Moreover, this study gave a great deal of insight into how branding does play into the consumers perceived eating quality.

Branding of Other Beef Products

First developed in 1916, the USDA grading system was first used as a way to report consistent market grades of beef carcasses (USDA, 2017). The initial standards were revised in 1926, which lead to the publishing of Official United States Standard for the Grades of Carcass Beef (USDA, 2017). Ultimately, these standards served as the foundation and premise behind the voluntary beef grading services that began in 1927 and eventually gave way for branded beef programs to be started. The first branded beef program to be established with the United States Department of Agriculture (USDA) was in 1978 with Certified Angus Beef (USDA, 2021b). Now, there are over 100 different branded beef programs registered with the USDA (USDA, 2021b). Of those programs, many include a breed requirement of Angus or Hereford, both of which have established programs for breed and hide color requirements that an animal must meet to be considered for the programs.

Much like ground beef, few studies have looked at the impact of branding and everything that can be attached to the front of the package on other beef products. We know from numerous studies that have looked at the impact of USDA quality grades and marbling on the eating quality of various beef cuts, that as quality grade increases the palatability traits of these also increase and become for desirable for the consumer (Smith et al., 1985; O'Quinn et al., 2012; Hunt et al., 2014; Corbin et al., 2015; Olson et al., 2019). When evaluating and purchasing beef products, the U.S. consumer tends to focus on the color, marbling, lean value, and USDA quality grades as well as their previous eating experiences (Umberger et al., 2000; Umberger et al., 2009a; Claborn et al., 2011)**.** Additionally, Savell et al. (1989) simulated a retail display setting in different cities and asked consumers to purchase beef retail cuts of different grades, prices, and trim levels. General appearance, color and the absence of connective tissue were shown to be the largest factors in cut selection criteria, while leanness, flavor and price made up the major purchasing factors. Moreover, Morales et al. (2013) suggests that those who are concerned more about quality, as well as having an appreciation for branded cuts are more likely to purchase branded beef.

More recently, Ron et al. (2019) looked at the effect of disclosing production practice and brand information on beef top loin steaks in a blind, true informed and false informed consumer panels in a series of two experiments. Consumers in the first experiment first ate product in a blind panel and were then falsely informed about the product they were eating in a second panel in which consumers ate the same set of steaks. This process was duplicated during the second experiment, except for consumers were then informed of the actual treatment they were eating. In the false informed portion, consumers ratings for tenderness and juiciness of naturally produced and processed steaks decreased from the blind to the false informed testing. Moreover,

grass and organic claims increased the flavor and overall liking when the products attributes were falsely disclosed. Tenderness and juiciness ratings decreased for CAB identified product, as consumer were falsely informed about a product that is typically associated with a high level of eating quality. This in contrast to the true disclosure portion in which CAB received the greatest increase in consumer ratings for flavor and overall liking versus the blind portion. Less change was observed in the consumer ratings when the consumer was informed of the actual treatment versus when they were falsely informed. The results found in this study were similar to the ones found by Wilfong et al. (2016b) who also utilized beef top loin steaks to evaluate the effect of USDA grade, CAB and Angus based label claims on the consumers perception of palatability. In the case of this study, consumers were fed in a blind panel and then in a panel where the product label was showcased, and information was given about the product. Consumers in this study ranked price, steak color, and size, weight, and thickness of steak as their most important traits when purchasing fresh beef steaks. When evaluating the change in consumer ratings when information was given, Prime, and CAB had the greatest change in consumer ratings for tenderness in comparison to Choice and Select but were similar to the change found in the Angus Select treatment (Wilfong et al., 2016b). Moreover, Prime, CAB and Angus Select had a greater change in the consumer ratings for overall liking when information was provided compared to Choice and were similar to Select. While Prime, CAB and Angus Select received a lift in palatability ratings due to disclosing brand information, the steaks labeled as Choice and Select did see the same lift (Wilfong et al., 2016b). Authors in this study cited the use of “Angus” branding as possessing an increased level of quality with the consumer. This studied further highlighted the importance of the consumers use of extrinsic cues as a means of identifying a

product that is to be expected as having a high-quality eating experience, whether that eating experience is actually present.

Effect of Price

The price of ground beef in controlled by numerous factors including the live price of cattle and other demand factors such as seasonality and holiday trends. When looking at historical data for the price of 100% ground beef, the average price per pound for ground beef in January 2010 was $2.279 (U.S. Bureau of Labor Statistics, 2021). If we forward to January 2021, the price of ground beef has risen to $3.965 per pound. Moreover, the price for ground chuck has risen from $2.825 in January of 2010 to $4.310 in January 2021. The average price of lean and extra lean ground beef in January 2010 was $3.397 per pound in comparison to January 2021 the price per pound was $5.705. In comparison, ground beef is a cheaper priced commodity in comparison to beef steaks which were priced at $8.250 per pound at retail in January of 2021.

Valenzi and Andrews (1971) found a positive relationship between the taste quality and pricing of products. If price is the only cue available to consumers when purchasing, the perceived quality of the product will be positively related to the price (Dodds et al., 1991). However, when additional information is provided about the brand of a product the positive price relationship fades. When evaluating non-food items, price and extrinsic cues play a lesser role to intrinsic cues and the actual product characteristics (Pincus and Waters, 1975). The perceived quality of lower priced items remains no matter what the intrinsic cues are and often carry over despite there being a potential increase in quality. Consumers who are income strained or more sensitive to price are going to be more unwilling to pay the premium associated with branded products (Umberger et al., 2009b). During periods of economic hardship, consumers are more likely to purchase the lowest cost item that may come as a detriment to their diet (Andreyeva et

al., 2010). Moreover, consumers are more likely to increase their caloric intake at the expense of lower quality, cheaper foods when price becomes the most important factor when purchasing food (Andreyeva et al., 2010). In contrast, when consumers do see an expensive product, they mostly associate that product as being healthier (Jo and Lusk, 2018). Moreover, if the health benefits of a product are given to the consumer, the consumer is more willing to purchase the product and at a higher price due to the perceived benefits.

Few studies have looked solely at the basis of price on the consumers' willingness to consume and purchase a product. However, in numerous pieces of meat science literature consumers purchasing motivators have been recorded. In previous studies conducted at Kansas State University, price was indicated as the most important purchasing motivator when purchasing fresh beef steaks (Vierck et al., 2018; Olson et al., 2019; Prill et al., 2019) and ground beef (Wilfong et al., 2016a). This is consistent with results reported at other institutions that have also asked about consumers purchasing motivators (Lucherk et al., 2016; Vierck et al., 2021). Previously, when looking at marketing a branded beef product Wachenheim et al. (2000) found the socioeconomic status of consumers as an important representation of the premium the consumers were willing to pay for the branded product.

Labeling of Ground Beef Products

In the most recent National Meat Case Study, production-based claims, such as natural and organic, found on the front of packages had a significant increase with natural claims being found on 38% of meat packages (Kelly, 2016). Organic claims on ground beef alone grew from 1.1% to 5% packages in a five-year timespan. Additionally, only 4% of packages found in the retail case were un-branded, which changed from the previous study in 2010 where 27% of packages were un-branded. While many of the SKUs for beef, pork and lamb declined from

2010, there was an increase of the number of ground beef packages available at retail. Ward et al. (2008) in a sampling of supermarket data in four major metropolitan areas found packaging to be more important on ground products than whole muscle steaks and roasts. In addition, ground beef packages that were tied to a special brand or label were more heavily preferred by consumers than those who exhibited less information on the label. Labeling of all meat products in the U.S. is governed by the USDA Food Safety and Inspection Service (FSIS) arm, where labels must meet minimum requirements and claims are verified prior to packages being labeled (USDA, 2005).

Consumers utilize labels to make their purchasing decisions and utilize the information to form an opinion of the perceived quality of the products. Samant and Seo (2016) found that as consumer understanding and trust in label claims increased, so did their perceived perception of eating quality regarding tenderness, juiciness and flavor. Moreover, the quality perception that is induced from labeling claims is dependent on the consumers understanding of the label and their ability to relate to what is being communicated. Furthermore, Spinelli et al. (2015) found there to be a disconfirmation of liking when a product went from unbranded to branded and emotions decreased during the informed testing versus the blind testing. Alternatively, consumers are willing to pay for redundant food labels such as those that claim sea salt is a non-GMO product due to their willingness to pay for "premium" foods (Wilson and Lusk, 2020). Ultimately, Banović et al. (2009) found that consumers use the extrinsic cues on the product labeling and branding to then judge the actual intrinsic cues that are unique to the product. Consumers must be able to make inferences about the quality of the product at time of purchasing, if a product is not able to do so then it will most likely not be purchased.

Natural claims on labels are allowed when a product does not contain any enhancements beyond the natural state and is minimally processed such as grinding meat or separating into whole, intact foods parts (USDA, 2005). Moreover, products that do have a natural or all-natural label must also be accompanied by a statement of what is meant by the natural term, however, there is not a certification or audit required. Participants in a study conducted by Abrams et al. (2010) indicated that "all-natural" label was misleading and often confused with organic labeling. Furthermore, Dominick et al. (2018) showed that many consumers associate the natural labeling with improved taste and elevated nutritional benefits. Moreover, women are more receptive to "all natural" labeling than men. Many consumers perceive "all-natural" to involve the production practices that are actually part of the USDA organic standards (Abrams et al., 2010). Galati et al. (2019) analyzed consumers' willingness to pay for "natural wine" and found consumers were willing to pay a premium for the natural product. Consumers were positively influenced by the information found on the label which included the production methods by which the wine was produced.

The Organic Foods Production Act of 1990 established the USDA Organic program and set about the guidelines for its framework. If we look at the standards for a product to be labeled as USDA Organic, the USDA has set a defined set of standards for a product to carry the USDA Organic seal (USDA, 2021a). USDA governs the way organic products are to be produced to promote ecological balance, soil, and water quality, and decrease the use of synthetic materials. Moreover, those participating in the organic program must be involved in a third-party audit to prove that they are following organic practices and regulations. Organic labeling to many consumers sends the cues of having fewer residues, while also being safer and healthier than conventionally raised product despite their not being any health-related benefits (Van Loo et al.,

2010). Organic production methods do have a higher cost of production. Therefore, the cost of organic items is a limiting factor for some consumers (Van Loo et al., 2010). Harper and Makatouni (2002) found that many consumers relied upon their ethical motivations for purchasing organic products. Many of those consumers did confuse organic with free-range even though the production practices are vastly different from one another. When evaluating wine, consumers perceived organic wine to be higher quality and tastier (Gassler et al., 2019). Moreover, those consumers had a higher willingness to pay for the perceived better taste for the wine despite it being the same as the conventionally labeled products. Additionally, in an Italian study looking at organic and conventional beef, consumers had a higher expected liking for organic beef prior to it being fed to them and had a higher actual liking score for organic (Napolitano et al., 2010). Ultimately, numerous authors point to there being a "organic halo" effect with consumers that gives them an increased sense of quality and taste when they are aware of a product being organic (Abrams et al., 2010; Napolitano et al., 2010; Gassler et al., 2019).

Locally sourced and locally grown have become buzzwords for consumers as they have gone through the COVID-19 pandemic. There is no official designation for what constitutes as local; however, some USDA programs utilize it as being a product that is less than 400 miles from where it is produced or it is within the state the product is produced (Tropp, 2015). Moreover, the distance that is defined as local varies greatly by region, especially in places that are sparsely populated (Martinez et al., 2010). Consumers tend to view locally sourced food as more environmentally friendly, healthier, nutritious, and more likely to be organic or naturally grown (Bacig and Young, 2019). Numerous restaurant and foodservice operations have adopted local food items as a differentiation strategy to appeal to consumers (Martinez et al., 2010).

Furthermore, Bacig and Young (2019) found the use of locally sourced food on restaurant menus increased consumers' willingness to pay for products, but also increased the bias towards the products on the menu that were locally sourced versus those that were not labeled as locally sourced. Kumpulainen et al. (2018) evaluated the expectations that were generated by product origin location. Locally sourced meat had a higher product perception and a larger willingness to pay than domestically and foreign sourced product. Alternatively, Khachatryan et al. (2018) found the local economic benefits to be perceived as the most beneficial mechanism of local products when evaluating the impact of Florida's agriculture source marketing campaign. Again, we see a halo effect with the use of locally sourced, even though consumers use a broad and varied definition for what classifies as locally sourced.

Grass-fed beef has become an increasingly popular product at retail. For a product to be labeled as grass-fed, it must be backed up by production records that give in detail the management practices of the animal (FSIS, 2019). Moreover, FSIS defines grass-fed as being fed with only grass or forage and having continuous access to pasture during the growing season until slaughter. In 2020, grass-fed beef products accounted for approximately 24% of the past month beef purchases by consumers and accounted for 97 million pounds of product sold at retail (Beef Checkoff, 2021). Several authors have found consumers to be willing to pay a premium for grass-fed beef for the perceived health benefits of the product (Umberger et al., 2009a; Carabante et al., 2018). When evaluating consumers' willingness to pay for cheese with different attributes, animals having access to grass received a higher willingness to pay by consumers in the study (Bir et al., 2020a). Alternatively, Ellison et al. (2017) found consumers to be less concerned with the claim of animals being fed a grass-fed diet in comparison to other animal production claims. However, consumers in the study did confuse grass-fed to be

encompassing of other labels such as natural and organic. In the previously mentioned study by Ron et al. (2019), when true treatment information was given to the consumers grass-fed samples received an increase in flavor and overall liking ratings. Results from that study indicated that production practice information does influence consumers perceived eating quality and consumers resonate with the grass-fed information.

Numerous ground beef products have come to be labeled as being from "Animal raised without added antibiotics" or "Animal raised without added hormones". FSIS does not have any authority over animal raising claims, however, they do have the authority to ensure that labeling is truthful and accurate (FSIS, 2019). Moreover, when submitting label approvals to FSIS that have an animal production claim they must be accompanied by documentation to support the claim. Additionally, FSIS addresses that animal production claims including being raised without added antibiotics and hormones are voluntary marketing claims and the claims do not actually address the products characteristics or nutritional value (Food Safety Inspection Service, 2019). Most recently, Wemette et al. (2021) found that the reasoning for most consumers purchasing milk from cattle raised without added antibiotics stemmed from their conviction that animal antibiotic use posed a risk to their health. Additionally, almost 22% of the same consumers indicated they were willing to pay up to 20% more for the milk to be raised without added antibiotics. Additionally, Ellison et al. (2017) found the production claim "animals were not administered growth hormones" to be one of the most important claims across several production claims surveyed by consumers. Similarly, when purchasing whole turkeys for the Thanksgiving holiday many consumers indicated they were willing to pay more for "USDA certified Hormone use not permitted" (Bir et al., 2020b). Moreover, when studying consumers' willingness to pay

for cheese with varying label attributes Bir et al. (2020a) found that consumers were willing to pay more for a USDA, retailer, and industry verified antibiotic use free product.

Fast-food chain Wendy's coined the term "Fresh never frozen" in 1969 and has been a part of the chain's branding ever since (Wendy's, 2021). In turn, this branding has transferred over to the retail counter and other foodservice providers. When labeling packages at retail, FSIS defines fresh as any fresh, non-cured product who internal temperature has not been below -2°C, has not been treated with any antimicrobials or discoloration delaying substance (USDA, 2005). However, companies can utilize trademarks, company names and "fanciful names" containing the word fresh. Limited studies exist as to how U.S. based consumers perceive fresh versus frozen ground beef products. Wang et al. (2018) conducted a Chinese based experiment that investigated the preference of packaging and preservation methods in fresh pork. Consumers in the study indicated that they would discount frozen product and perceived the frozen pork to be not as fresh in comparison to traditional hot pork marketed in China. When presented with information about the freezing and preservations methods, and their effect on pork quality, many consumers perceptions changed to be more in favor of the frozen product. Fresh beef accounts for the largest volume of meat at retail and therefore, consumers are more accustomed to purchasing fresh product than frozen.

To catch the attention of consumers, "premium quality" is a branding cue that has been utilized on numerous package labels in recent years. FSIS does not have any specifications in which a product must quality for to be labeled as premium quality and are generally approved for use in commerce (USDA-FSIS, 2020). While no previous literature has investigated why "premium quality" resonates with consumers, Meyerding et al. (2018) suggests that labels that indicate a perceived quality heavily influence the consumers perception of the eating quality of

the product at purchasing. However, rarely will that transfer over to the actual eating quality when the product is similar in type to the unlabeled product.

Ultimately, the labeling of food products in the form of extrinsic cues for the consumer to base their purchase off influence the perception of those products. Several labeling terms have been classified as having a "halo" around them that drives the consumers purchase of the product. Moreover, many of animal production-based terms resonate greatly with consumers, however, consumers seem to lack a full understanding of those. Regardless, adding additional information to products gives consumers additional cues to base their purchase on and add to the amount that consumers are willing to pay for commodity products.

As one of the most widely consumed beef products available to consumers, ground beef is still a relatively understudied commodity in comparison to whole muscle cuts. The eating quality of ground beef is influenced by numerous factors including the fat content and primal source. Purchasing of ground beef at retail and in foodservice establishments is driven primarily by branding and labeling. Numerous intrinsic and extrinsic cues that consumers use to associate a product to an expected eating experience. It is therefore the goal of the forthcoming chapters, to evaluate the total effect of branding in the forms of price, primal source, fat content and labeling on the perceived palatability of ground beef.

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Chapter 2 - Impact of disclosing fat content, primal source, and price on consumer sensory evaluation of ground beef

Abstract

The objective of this study was to evaluate the effect of providing information about the fat content, primal source, and price on consumers' palatability ratings of ground beef from the same source. 80% lean / 20% fat ground beef chubs (n = 15 / panel type) were obtained, and 151.4 g patties were manufactured from the chubs. Chubs were assigned randomly to panels for one of three different panel types. The fat content panels had samples labeled as: 90% lean / 10% fat (90/10), 80% lean / 20% fat (80/20), 73% lean / 27% fat (73/27), lean and extra lean. Price point samples were assigned to one of five different points: ultra-high, high, medium, low, and ultra-low. Primal panel samples were labeled as: ground chuck, ground round, ground sirloin, and store ground. Each panel had one sample with no information given (NONE). Samples were evaluated by consumers (N = 305), who were informed of the treatment prior to evaluation, on 0-to-100-point line scales for tenderness, juiciness, flavor, texture, overall liking, and purchasing intent, and rated each trait as acceptable or unacceptable. Labeling ground beef as 90/10, 80/20 and 73/27 had a large increase ($P < 0.05$) in consumer ratings for tenderness, flavor, and overall liking. Informing consumers of the price of the product resulted in large increases ($P < 0.05$) for all palatability traits for samples labeled as ultra-high, high, medium, and ultra-low priced samples. Furthermore, attaching a primal blend label to the samples had a large increase ($P < 0.05$) for all the palatability traits evaluated for all four primal blend types. Additionally, the purchasing intent was increased ($P < 0.05$) for samples when consumers were informed of the price and primal blend. Ultimately, providing consumer with information about

the fat content, price, and primal blend type influences their perceived palatability of ground beef.

Key words: consumer, Ground Beef, fat content, price, primal blend

Introduction

Consumers are provided with numerous pieces of information related to ground beef products at the retail case. The information used can vary from the price, fat content/leanness, animal or product production practices, primal source, weight, thickness, size of package, quality level and even the brand of the meat being purchased. At the time of purchase the information in the form of both intrinsic (actual product traits) and extrinsic (outside factors) cues is balanced (McIlveen and Buchanan, 2001). However, most of the previous research evaluating ground beef palatability has all been blinded studies, where products of differing quality characteristics have been evaluated (Berry and Leddy, 1984; Troutt et al., 1992; Blackmon et al., 2015; Kerth et al., 2015). Recent studies utilizing both ground beef and beef steaks have attempted to identify the effect of providing information about the brand and production practices on consumers' eating experience and have indicated that these characteristics influence the overall eating experience consumers receive (Wilfong et al., 2016a, 2016b; Ron et al., 2019). Yet, it is known consumers utilize several other characteristics of ground beef including the price, primal source, and fat content in addition to the brand of ground beef when they are making purchasing decisions.

It is known that a positive relationship between the price of a product and the perceived taste of that product exists, with increased price being associated with increased quality perceptions (Valenzi and Andrews, 1971). The perceived quality of a product by a consumer will be solely related to price, if price is the only cue available at the time of purchase (Dodds et al., 1991). Increasing the price of more palatable food products often shifts consumers' demands to

lower priced, less palatable food (Cabanac, 1995). Price has been indicated by consumers as the most important motivator when purchasing beef products (Wilfong et al., 2016a; Vierck et al., 2018; Olson et al., 2019; Vierck et al., 2021). In the last decade, the price of ground beef has risen from $5.02 per kg in January 2010 to $8.74 per kg in January 2021 (U.S. Bureau of Labor Statistics, 2021). Yet, no studies involving meat or ground beef have looked at how the price plays into the consumers perceived palatability of the product.

The popularity of primal and sub primal specific blends has increased significantly in the last decade as "premium blend" concepts have been popular throughout the industry. Data from supermarket scanners was reported by Ward et al. (2008) and found ground chuck to be purchased more frequently and at a higher price than commodity product, indicating the popularity of primal blends at the retail level. Numerous recent studies have evaluated the palatability characteristics of ground beef differing primal and sub-primal blends (McHenry, 2013; Blackmon et al., 2015; Kerth et al., 2015; Beavers, 2017). However, the studies have produced conflicting results related to the palatability of these premium blend and primal-specific concepts utilizing both consumer and trained sensory panelists. To date, no research has evaluated how attaching a primal source label to a ground beef product affects the consumer's perceived eating experience of the product.

The impact of fat content on ground beef palatability was thoroughly investigated throughout the health craze of the 1980s and 90s (Berry and Leddy, 1984; Troutt et al., 1992; Miller et al., 1993; Berry, 1994; Wong and Maga, 1995). However, this research was all conducted with products that varied in quality. Speer et al. (2015) reported 70 to 77% lean ground beef accounted for the largest percentage of ground beef sales at retail and indicated the growth of higher fat blends in both the retail and food service sectors. In 2019, 70 to 77% lean

ground beef again accounted for the largest increase in sales and pounds sold among all ground beef sold (Beef Checkoff, 2021). Moreover, increasing the fat content of ground beef decreases the price of the product in comparison to higher lean points being marketed (Lusk and Parker, 2009). While research exists in other food products on the impact of disclosing fat content on consumers' impressions of palatability (Solheim and Lawless, 1996; Westcombe and Wardle, 1997), this has not been evaluated in ground beef.

Ground beef represents one of the most widely consumed beef products as 46% of the total U.S. retail beef consumption (Schulz, 2021). Currently, no work has evaluated how many of the various information cues presented to consumers at the point-of-sale impacts consumer's perceptions of the palatability traits of the product. Therefore, the objective of this study was to assess the impact of providing consumers with information about the price, fat content, and primal source of ground beef on the consumer's eating experience.

Materials and Methods

All the procedures outlined within this study were approved by the Institutional Review Board at Kansas State University (IRB #7440.7, February 2, 2021).

Ground beef preparation

Since the objective of this study was to assess the impact of labeling the price, fat content and primal source on ground beef, the research team utilized a method to assess the impact of providing the various forms of information while keeping the actual product identical. Ground beef was allotted to the different treatments so that each consumer would be sampling 5 or 6 samples that were labeled with the different attributes being studied despite there being no actual differences in the product. One sample was designated to have no information associated with it so that a "control" could be established. All the product quality and characteristics of the ground

beef were kept as similar as possible to help eliminate any variability within the ground beef and test only the effect of providing different labeling information.

Ground beef chubs (*N* = 30; 4.54 kg chubs) of 80/20 ground beef (IMPS #136) from the same lot and production day were obtained from a food purveyor and shipped to the Kansas State University Meat Laboratory, in Manhattan, Kansas. Chubs were stored under refrigeration at 0 to 4°C prior to patty formation.

Ground beef chubs were fabricated 11 days after the date of manufacture using a patty former (Super Model 54 Food Portioning Unit, Hollymatic, Countryside, IL) into 113.4 g patties that were approximately 10-cm in diameter and 1-cm thick. Chubs (*n* = 15 / panel type) were randomly assigned to one or two consumer panel sessions so that all patties consumed within a single panel session came from the same chub to keep patties as similar to one another as possible. Ground beef patties were kept in ordered pairs and were randomly labeled according to the order in which they were formed. Two pairs of ground beef patties from each chub were assigned to texture profile analysis **(TPA)** and shear force analysis. The remaining patties within each chub were designated for consumer sensory analysis and assigned to one of 3 different informed panel types: fat content, primal source, or price. Within the fat panel, patties were designated to one of five different fat content treatments: 90% lean/10% fat **(90/10)**, 80% lean/20% fat **(80/20)**, 73% lean/ 27% fat **(73/27)**, lean, or extra lean. Primal source patties were assigned to 1 of 4 different labeled primal blend treatments: ground chuck, ground round, ground sirloin, or store ground. Price patties were assigned to one of 5 different price point treatments: “ultra-high”, “high”, “medium”, “low”, or “ultra-high”. Additionally, within each set of panels one patty pair was designated as a blank **(NONE)** with no label information designated to serve as a control for the panel. Patties were crust frozen on plastic trays and packaged using a

rollstock packaging machine (Model Bulldog 42a300, UltraSource, Kansas City, MO). All samples were then frozen at -40°C until analysis.

Shear force testing was conducted according to the American Meat Science Association (AMSA) guidelines for instrumental tenderness utilizing the straight edge blade attachment (AMSA, 2015). Moreover, TPA was conducted according to the procedures from Bourne (1978) and the AMSA guidelines for tenderness testing (AMSA, 2015).

Consumer sensory analysis

Consumer panelists (n = 315; 105 / panel type) were recruited from across the Midwest and monetarily compensated for their participation. All consumers were fed under regular florescent lighting. Panels lasted approximately 1 h and 21 consumers were present for each panel. For each panel type, a total of 5 sessions were held. During the sessions, each panelist was given a plastic fork, napkin, an empty expectorant cup, as well as water, apple juice, and unsalted crackers to use as palate cleansers between each sample. Prior to evaluating the samples, consumers were given verbal instructions to explain the evaluation procedures, how to cleanse their palate between each sample, and how to use the digital survey.

For each panel, patties were thawed at 2 to 4°C for 20 to 24 h prior to cooking. All patties were cooked on clam-shell style grills (Cuisinart Griddler Deluxe, East Windsor, NJ) set to 177°C. An endpoint temperature of 71°C was targeted and recorded using a thermocouple type thermometer (Doric 205, Beckman Industries). Once cooked, patties were sliced into 8 equally sized triangular pieces using a cutting guide, plated, and served immediately to a predetermined consumer.

Prior to their evaluation of each sample, consumers were provided with the designated additional labeling information about each sample. A screen was used to project the information

about each sample and consumers were verbally informed of the additional information for the sample as well. Samples were fed in a random order for each panel session. A blank screen was shown for the NONE sample, and consumers were told they were eating a ground beef sample with no information provided about it. For the price panels, the average price of ground beef was obtained from several retailers in the Manhattan, KS area for the week of August 17, 2020. The average price was determined to be $8.27/kg which was set as the medium sample. Prices were then set to be 33% and 66%, higher and lower than the medium or average price. Therefore, the ultra-high price was $13.78/kg, high was $11.02/kg, low was $5.51/kg and ultra-low was set at $2.75/kg. Price per pound was provided to the consumers.

Consumers were provided with electronic tablets (Lenovo TB-8505F) to fill out preloaded surveys (Qualtrics XM, Provo, UT). The first page of the survey asked consumers to give demographic information about their gender, household size, marital status, ethnicity, income, education, as well as identifying their weekly ground beef consumption, preferred degree of doneness for ground beef and the most important palatability trait when consuming ground beef. Additionally, consumers were asked to rate the importance of several traits they would consider when purchasing ground beef at retail on 0 to 100-point line scales that were verbally anchored at 0 = extremely unimportant and 100 = extremely important. For each sample, consumers were asked to rate the juiciness, tenderness, flavor liking, texture, and overall liking on 0 to 100-point continuous line scales as well as give their purchasing intent. Scales were descriptively anchored at each end and at the midpoint: 0 = extremely dry, tough, dislike flavor/texture/overall extremely, extremely unlikely; 50 = neither juicy nor dry, neither tough nor tender, neither like nor dislike, and neither likely nor unlikely; 100 = extremely juicy, tender, like

flavor/texture/overall extremely, and extremely likely. Furthermore, consumers were asked to rate each palatability trait as either acceptable or unacceptable.

Change in consumer rating due to information disclosure

To account for changes in consumer scores when information was provided, the change in panelist ratings was calculated for each sample as a change in rating from the NONE score. To calculate this, the consumers rating for the labeled sample was subtracted from the rating for the NONE sample, divided by the NONE sample and multiplied by 100 to find the percentage change in the palatability scores as a result of treatment disclosure.

Statistical analysis

The PROC GLIMMIX procedure of SAS (SAS Institute Inc., Cary, NC) was used for statistical analysis. An α of 0.05 was considered significant for all treatment comparisons. All data were analyzed as a completely randomized design. Moreover, for all sensory data the random effect of panel session was used, and consumer acceptability data was modeled using a binomial error distribution. The demographic data was summarized using PROC FREQ procedure of SAS. Finally, the Kenward-Roger adjustment was used through all analyses.

Results

Fat content panels

Demographic results for the 305 participants in all three panel types can be found in Table 2-1. Gender was split almost evenly (49.5% and 50.5%) among the male and female participants in the fat panel. Additionally, most participants were married (70.6%), Caucasian (97.9%), and from a household of 2 people (40.2%). Over half of the participants made over $50,000. More than 70% of the participants had an education beyond the high school level, with more than 50% of the participants indicating they were a college or post-college graduate.

Participants indicated that flavor (68.5%) was the most important palatability trait when consuming ground beef, followed by juiciness (20.7%). In addition, medium-rare was the most preferred degree of doneness at 29.4% of participants, followed by medium (27.2%) and medium-well (23.9%). Furthermore, more than 50% of participants consumed ground beef from one to three times per week. All the consumer participants were asked to rate the importance of 18 different traits when they are purchasing ground beef at retail and the results are recorded in Table 2-2. When asked to rate the importance of various traits as they are purchasing ground beef at retail, "Fat content" was rated by consumers as similar ($P > 0.05$) in importance to "animal welfare", "appearance – lean to fat ratio", "color" and "locally raised", but more ($P < 0.05$) important than all other traits evaluated. Finally, consumers in the fat panels identified "natural or organic claims" as similar ($P > 0.05$) in importance to "animal fed a grass-based diet", but the least ($P < 0.05$) important when compared to the other traits evaluated.

Results for the consumer sensory ratings for the fat panels can be found in Table 2-3. Consumers found very few differences when information related to fat content was disclosed prior to sample evaluation. Consumers rated 73/27 labeled ground beef juicier ($P < 0.05$) than 90/10, and extra lean labeled ground beef, but similar ($P > 0.05$) in juiciness to NONE, lean, and 80/20 labeled products. No differences ($P > 0.05$) were found in the ratings for tenderness, flavor liking, texture liking, and overall liking among the 6 different treatments; however, all mean ratings fell above the midpoint. Moreover, no differences ($P > 0.05$) were found in consumers' likelihood to purchase the 6 treatments.

Despite the limited differences in consumer ratings, consumers' perception of the ground beef they were consuming when additional labeling information was provided did change (Figure 2-1). There was an increase ($P < 0.05$) in the ratings for tenderness for 90/10 (20.1%),

80/20 (21.2%), and 73/27 (24.2%) labeled products when the fat content was provided to consumers. Additionally, 73/27 labeled samples had a 24.6% increase ($P < 0.05$) in the ratings for juiciness. Large increases ($P < 0.05$) were also found in the ratings for flavor liking for 90/10 (25.2%), 80/20 (25.3%), 73/27 (32.6%), and lean (15.3%) labeled ground beef. Additionally, when the fat content was provided, texture liking ratings increased ($P < 0.05$) for 73/27 (22.1%) and extra lean (19.6%) labeled treatments. Finally, there was a large increase ($P < 0.05$) in ratings for overall liking for 90/10 (22.2%), 80/20 (27.5%), and 73/27 (27.1%) labeled ground beef when labeling information was provided.

Consumers were asked to rate each palatability trait as either acceptable or unacceptable as they were evaluating each sample (Table 2-4). When evaluating tenderness, a higher ($P < 0.05$) percentage of 80/20 labeled ground beef was rated as acceptable in comparison to extra lean labeled and NONE but was similar ($P > 0.05$) to the percentage of lean, 90/10, and 73/27 labeled samples rated as acceptable. Moreover, lean labeled ground beef had a similar ($P > 0.05$) percentage of samples rated as acceptable for tenderness compared to all other treatments. For juiciness, 90/10 labeled ground beef had the lowest ($P < 0.05$) percentage of samples rated as acceptable in comparison to 80/20, 73/27 labeled samples, and NONE, but was similar to the percentage of lean and extra lean labeled ground beef rated as acceptable. There were no differences ($P > 0.05$) in the percentage of samples rated as acceptable for flavor, texture, and overall, for all treatments evaluated.

Figure 2-4 presents the means for the change in the percentage of samples rated acceptable for labeled samples when information about the fat content was provided. There was an increase ($P < 0.05$) in the percentage of samples rated as acceptable for tenderness for 90/10, 80/20, and 73/27 labeled samples in comparison to extra lean labeled products which had a

decrease ($P < 0.05$) in the percentage rated as acceptable when information was provided about the treatment. Conversely, when evaluating juiciness, extra lean and 90/10 labeled samples had a larger ($P < 0.05$) decrease in the percentage of samples rated as acceptable in comparison to 80/20 and 73/27 labeled samples when fat content was disclosed. A decrease ($P < 0.05$) in the percentage of samples rated as acceptable for juiciness was found when samples were labeled as 90/10 and extra lean. Additionally, providing the fat content to consumers increased ($P < 0.05$) the percentage of 80/20 labeled samples rated as acceptable for texture. Providing the fat content to consumers did not ($P > 0.05$) increase/decrease the percentage of samples rated as acceptable for flavor and overall, for any of the treatments.

Price panels

Participants involved in the price panel were similar to those in the fat panel, and were predominately married (73.9%), Caucasian (98.9%), and from a 2-person household (40.5%) (Table 2-1). Different from the fat panel, 63.3% of the participants were female. Like the fat panel group, over 50% of the participants made more than $50,000, and were college or post college graduates. Again, participants identified flavor as being the most important palatability trait when consuming ground beef at 75.3% of participants. Medium-well was the most (34.9%) preferred degree of doneness in the price panel group, followed by a medium degree of doneness preference by 30.3% of participants. Furthermore, similar to the fat panel 50% of participants consumed ground beef 1 to 3 times per week.

Consumers were asked to rate the importance of 18 different traits as they are purchasing ground beef at retail (Table 2-2). “Color” was similar ($P > 0.05$) in importance to “fat content”, “animal welfare”, “appearance – lean to fat ratio”, and “price” for consumers in the price panels but was rated as more ($P < 0.05$) important than the rest of the traits evaluated. “Price” was rated

by consumers in the price panels as similar ($P > 0.05$) in importance to “fat content”, “animal welfare”, “appearance – lean to fat ratio”, “color”, “locally raised”, “nutrient content”, and “animal fed a grain-based diet”. Also, consumers in the price panels rated “fresh never frozen” and “natural or organic claims” as similar ($P > 0.05$) to “pre-formed patty” and “animal fed a grass-based diet”, but less ($P < 0.05$) important than all other traits.

Consumers in the price panels identified the NONE sample as being the least ($P < 0.05$) juicy when compared to the ultra-high, high, medium, and ultra-low price labeled samples, but similar ($P > 0.05$) in juiciness to the low-priced product. Additionally, ultra-high, high, medium, and ultra-low labeled price samples were rated similar ($P > 0.05$) for juiciness. When evaluating flavor, consumers rated the NONE sample lower ($P < 0.05$) for flavor liking when compared to ultra-high- and medium-priced samples, but similar ($P > 0.05$) to high, low, and ultra-low priced ground beef. Consumers found no difference ($P > 0.05$) among the treatments for tenderness, texture liking, overall liking and purchasing intent.

Changes were observed when consumers were informed of the price of the ground beef prior to consuming the samples (Figure 2-2). Large increases ($P < 0.05$) in tenderness ratings were found for the ultra-high (23.9%), high (17.4%), medium (19.4%), and ultra-low (20.3%) priced samples when the price was conveyed to consumers. Similarly, juiciness ratings also increased ($P < 0.05$) for ultra-high (46.1%), high (44.4%), medium (47.6%), and ultra-low (46.3%) priced samples when the price was known. Additionally, flavor liking ratings increased ($P < 0.05$) by more than 34% for all price labeled samples. Likewise, texture liking also increased ($P < 0.05$) for all priced samples by more than 28% when the price was disclosed to consumers. Ultra-high- and medium-priced samples had a larger ($P < 0.05$) increase in overall liking ratings when compared to the low and ultra-low-priced samples, however, the high-priced

ground beef had a similar ($P > 0.05$) increase in overall liking ratings when compared to the other four treatments. Furthermore, the purchasing intent ratings all increased ($P < 0.05$) by more than 45% when consumers were informed of the price of the ground beef they were consuming.

When evaluating juiciness, there was a higher ($P < 0.05$) percentage of samples rated as acceptable for the ultra-high- and medium-priced samples in comparison to low priced and NONE. Moreover, there was a higher ($P < 0.05$) percentage of medium-priced samples rated as acceptable for flavor in comparison to the high, low, and ultra-low-priced samples, and NONE; but was similar ($P > 0.05$) to the percentage of samples rated as acceptable for the ultra-high-priced samples. Additionally, medium priced ground beef had a higher ($P < 0.05$) percentage of samples rated as acceptable overall when compared to low-priced and NONE but was similar ($P > 0.05$) to the percentage of samples rated as acceptable overall for ultra-high, high, and ultra-low-priced samples. For tenderness and texture, there was no difference ($P > 0.05$) in the percentage of samples rated as acceptable among the treatments.

Informing consumers of the price of the ground beef they were consuming resulted in changes in percentage of samples rated as acceptable (Figure 2-5). There was a greater ($P < 0.05$) increase in the percentage of samples rated as acceptable for juiciness when priced in the ultra-high, high, medium, and ultra-low prices in comparison to the low-priced samples. Moreover, there was a greater ($P < 0.05$) increase in the percentage of samples rated as acceptable for flavor when priced at the medium price in comparison to high, low, and ultra-low-priced samples, but was similar ($P > 0.05$) to the change of the ultra-high-priced samples. There was a large ($P < 0.05$) increase in the percentage of samples rated as acceptable for the ultra-high (12.4%), high (11.1%), and medium (13.3%) priced samples when the price was given to consumers prior to

sample evaluation. Providing the price to consumers did not ($P > 0.05$) change the percentage of samples rated as acceptable for tenderness and texture for any of the price points.

Primal source panels

There was a higher percentage (60.6%) of male participants in the primal panel than the fat and price panels. Similar to the fat and price panels, participants in the primal panel were again married (66.4%) and from a 2-person household (39.1%), but different in ethnicity makeup from the fat and price panels as 15.2% of the participants were Hispanic and 78.1% were Caucasian. Once again, income was evenly distributed over all the participants, with over 50% of the participants in the primal panel making more than $50,000. Likewise, over 50% of participants were college or post-college graduates. Consumers again identified flavor as the most important palatability trait when consuming ground beef at 63.5% of participants, followed by juiciness at 16.3%. Well done was the most (32.4%) preferred degree of doneness in the primal panels. Finally, similar to the fat and price panels more than 50% of the participants consumed ground beef one to three times per week.

"Fat content" and "price" were rated similar ($P > 0.05$) in importance to "appearance – lean to fat ratio" and "color" by consumers in the primal panels when purchasing ground beef, but more ($P < 0.05$) important than all other traits evaluated. Additionally, consumers in the primal panel rated "primal source" as similar ($P > 0.05$) in importance to "animal fed a grain-based diet", "size, weight, and thickness", "nutrient content", "locally raised", and "animal welfare". "Preformed patty" and "natural or organic claims" were rated similar ($P > 0.05$) to "packaging type", "brand of product", "animal not administered antibiotics", and "animal fed a grass-based diet", but the less ($P < 0.05$) important than all other traits evaluated.

Of the three groups of information looked at in this study, primal blend type labeling had the largest impact on the palatability traits evaluated. Consumers rated ground chuck and ground sirloin labeled samples higher ($P < 0.05$) for juiciness than ground round labeled and NONE samples, but similar ($P > 0.05$) to store ground labeled ground beef. Likewise, ground chuck and ground sirloin labeled samples were rated as more ($P < 0.05$) tender than NONE by consumers but were rated similar ($P > 0.05$) to ground round and store ground labeled samples. Conversely, ground sirloin labeled ground beef was rated higher ($P < 0.05$) for flavor liking when compared to ground round labeled and NONE samples, but was similar ($P > 0.05$) to ground chuck and store ground labeled ground beef. Ground chuck labeled product was rated higher ($P < 0.05$) for texture liking when compared to labeled samples of ground round, store ground, and NONE. For overall liking, NONE was rated lower ($P < 0.05$) overall than ground chuck, ground sirloin, and store ground labeled products, with ground round labeled samples similar ($P > 0.05$) to all other treatments. When asked about their likelihood to purchase the products, consumers were more ($P < 0.05$) likely to purchase ground chuck labeled product in comparison to those labeled as ground round, store ground, and NONE.

Ground chuck labeling had a greater ($P < 0.05$) increase in consumers tenderness scores in comparison to ground round, and store ground labeled samples (Figure 2-3). Moreover, large increases ($P < 0.05$) in juiciness ratings were observed for ground chuck (36.3%), ground round (29.0%), ground sirloin (34.3%), and store ground (29.5%) labeled products when primal blend was conveyed. Likewise, flavor liking ratings increased ($P < 0.05$) by more than 45% and texture liking ratings increased ($P < 0.05$) by more than 25% when information was provided for all four primal treatments. Additionally, overall liking ratings increased ($P < 0.05$) for ground chuck (47.4%), ground round (27.6%), ground sirloin (45.5%), and store ground (28.1%) labeled

samples due to treatment disclosure. Furthermore, consumers purchasing intent increased ($P < 0.05$) by more than 50% for all four treatments when they were told the primal source prior to sample evaluation.

No differences ($P > 0.05$) were found among the four different primal source grinds and NONE for the percentage of samples rated as acceptable for tenderness, juiciness, flavor, texture and overall (Table 2-4). Over 80% of the samples for all five treatments were rated as acceptable for all the traits evaluated. Providing information about the primal source increased ($P < 0.05$) the percentage of samples rated as acceptable for juiciness for ground chuck and sirloin labeled samples (Figure 2-6). Additionally, providing consumers with information about the primal blend did not ($P > 0.05$) increase the percentage of samples rated as acceptable for tenderness, flavor, texture, and overall liking for the four primal blend labels.

Shear force and TPA

A sample from each chub was utilized for shear force and TPA analysis. The average mean plus or minus the standard deviation for shear force was 2.68 kg ± 0.21 across the 30 chubs of ground beef utilized. Moreover, TPA results (mean ± standard deviation) were as follows: hardness - 12.56 ± 1.68; cohesiveness – 0.39 ± 0.01; gumminess – 4.97 ± 0.75; springiness – 71.68 ± 2.38; and chewiness – 3.61 ± 0.63.

Discussion

Numerous intrinsic and extrinsic cues are used by consumers as they are evaluating and purchasing products to be consumed. Intrinsic cues such as the tenderness, juiciness, flavor, texture, fat content, primal content, and nutritional value are balanced with extrinsic cues such as the price, brand, production practices, processing characteristics, and advertising materials as consumers purchase beef and meat products at retail (McIlveen and Buchanan, 2001). The cues

evaluated at the time of purchase are the main form of communication that is present at the meat case (Nocella et al., 2010). Fenger et al. (2015) reports that to increase consumer interest in a product, the appeal of more natural or authentic attributes must be told to tell the story of the product. Therefore, in the case of our study attaching the primal blend source to the packages of ground beef increases the natural and authentic appeal of the product to consumers who are purchasing. Price and brand packaging play a large role in the consumers eating experience; however, taste is still the strongest attribute for determining consumer preference (Méndez et al., 2011). However, within the published literature few studies have investigated the impact of consumer knowing the price of the product they are consuming on the perceived palatability characteristics.

Over the last decade, numerous changes have occurred at the retail case in the marketing of ground beef and other meat products. In the 2015 National Meat Case Study, the percentage of ground beef packages sold in retail supermarkets and club stores increased by 1% and 2%, respectively from the previous study conducted in 2010 (Kelly, 2016). Moreover, the price of ground beef has increased from $5.02/kg in January 2010 to $8.74/kg in January, 2021 (U.S. Bureau of Labor Statistics, 2021). Consumers have increased their spending on beef by more than $113 per person from 1998 to 2013, further indicating the importance of understanding the impact of price on consumers perception of palatability (Speer et al., 2015). Additionally, consumers have changed their preferences for the fat content they are purchasing at retail. Speer et al. (2015) reported that from 2009 to 2013, the sales of 70 to 77% lean ground beef grew by 25.2%, and 85 to 89% lean ground beef grew by 26.5%, however, 90 to 95% lean ground beef only grew by 11.4%.

Fat content

The modern consumer places a great deal of emphasis on the type and amount of fat they are consuming. Previous work has indicated consumers are more concerned with the total amount of fat contained within the ground beef more so than they are with the price or package size (Lusk and Parker, 2009). Within the same consumer survey, consumers indicated they were willing to pay a premium for the 90/10 product over the 80/20 product (Lusk and Parker, 2009). Similarly, in the current study, fat content was identified as being the most important factor when consumers are purchasing ground beef in the current study. Research with other food products on cheese and yogurt of various fat percentages, found consumers to be less accepting of those with a lower fat percentage than those with a higher fat percentage when the fat content was disclosed (Westcombe and Wardle, 1997). Conversely, when evaluating packages of ground beef of various fat percentages, Pohlman (2017) found consumers to prefer ground beef labeled and unlabeled as 20% fat ground beef.

The impact of fat content on the palatability of ground beef has been extensively studied, especially during the health craze of the 1980s and 90s. Numerous authors have reported in studies involving trained panels that as the fat content of ground beef increases, so does the juiciness (Kregel et al., 1986; Troutt et al., 1992; Wong and Maga, 1995; Garzon et al., 2003). However, in the few studies involving consumers consuming ground beef of various fat percentages differing results for juiciness have been found. As ground beef increased from 10 to 30% fat content, no differences were found by Pohlman (2017), and Davis (2021). However, Wilfong et al. (2016a) found consumers to rate higher fat (73/27 and 80/20) ground beef as juicier than 90/10 ground beef in the blind portion of the study. Yet, when the same consumers were informed of the fat content their ratings changed for juiciness and ground beef labeled as

90/10 and 90/10 Certified Angus Beef Ground Sirloin had large increases in the consumer ratings for juiciness (Wilfong et al., 2016a). Consumers in the present study found differences in the juiciness of the treatments with higher fat content having an increased perception of juiciness, despite there being no differences in the actual product. Consumers are aware of the increased fat content of ground beef, as it is a labeled attribute of ground beef, and therefore, have the perception that the added fat in the ground beef contributes to the product being juicier. We propose that consumers have a biased opinion of what is known in the meat science literature as the lubrication theory. The lubrication theory states that intramuscular fat present around the muscle fiber of steaks and whole muscle cuts creates a juicer product (Smith and Carpenter, 1974). Consumers will associate a higher fat content in ground beef with an increased amount of juiciness.

In the current study, there was a difference in the percentage of samples rated as acceptable with extra lean labeled ground beef having the lowest percentage of samples rated as acceptable. Similarly, Davis (2021) found a higher percentage of 90/10 samples rated as acceptable for tenderness than 80/20 ground beef. Alternatively, when Wilfong et al. (2016a) informed consumers of the fat content on commodity product without the Certified Angus beef label consumers found a similar percentage of samples as acceptable for tenderness for both 90/10 and 80/20 ground beef. However, numerous trained sensory panels have concluded that fat content and tenderness are linearly related (Kregel et al., 1986; Berry, 1994; Wong and Maga, 1995; Garzon et al., 2003). Again, we conclude that consumers have a bias towards the tenderness found in higher fat ground beef. Furthermore, all the samples in the current study had shear force values that are considered very tender, and thus only minimal differences would have been detectable by consumers.

In the present study, we labeled two samples as lean and extra lean while also having a sample labeled as 90/10. For ground beef to be labeled as lean, it must contain less than 10 grams of fat and less than 4.5 grams of saturated fat per 100 grams (AskUSDA, 2019). To be labeled as extra lean, ground beef must contain less than 5 g of total fat and less than 2 grams of saturated fat (AskUSDA, 2019). Conversely, it is presumed that product labeled as 90/10 has approximately 10 grams of total fat contained within a 100-gram sample. Despite there being minimal differences nutritionally between the lean and 90/10 labeled sample, consumers were more favorable in their ratings for samples of 90/10 than lean labeled samples. Furthermore, labeling ground beef as lean and extra lean decreased the percentage of samples rated as acceptable. While some consumers are more receptive of lower fat products based on their needs, labeling ground beef in the present study as lean or extra lean was not as favorable as simply stating the lean and fat content.

Price impact

At the time of purchasing, consumers are many times faced with the challenge of selecting a product with a similar label but priced at varying price points. To no surprise, Valenzi and Andrews (1971) established that a synergistic relationship between the taste quality of a food product and the price of the product existed. Dodds et al. (1991) found that if price is the only available cue at the time of purchase, the quality perception found by the consumer will be solely related to the price of the product. Price along with brand packaging strongly affect the eating experience consumers have as they are consuming products (Méndez et al., 2011). While the number of unbranded products available to the consumer has greatly decreased in the last decade, the price of the unbranded products is sometimes the only cue available to the consumer. Previous meat science related studies have indicated price as the most important trait considered

by consumers purchasing steaks and ground beef at retail (Lucherk et al., 2016; Wilfong et al., 2016a; Vierck et al., 2018; Olson et al., 2019; Prill et al., 2019; Vierck et al., 2021). Consistent with those studies, consumers in our study also identified price as being an important trait when purchasing ground beef. However, we do not know if those consumers who identified price as the most important trait prefer higher or lower prices. We chose to utilize a range of prices based around the average market price to try to capture if consumers preferred high or lower priced items.

Labeling ground beef at the three higher price points resulted in significant increases for both consumer ratings and acceptability. It was hypothesized that there would be an advantage for the highest and lowest price categories, but consumers indicated a preference for the three higher price points over the two lower price points. Jo and Lusk (2018) report that if consumers see a higher priced food product, they more commonly associate that product as being healthier for them. Consumers in the current study could have potentially been swayed by the fact that the higher priced options had a greater benefit attached to them than the lower priced samples. Furthermore, Wachenheim et al. (2000) found consumers of higher socioeconomic status to be generally willing to pay a premium price for beef. In the present study, over 40% of the consumers made more than $75,000, which could make them more likely to be willing to pay for the higher priced product and thus perceive a palatability benefit.

One of the observations made in this study was the impact of the low versus ultra-low-priced samples. Consumer ratings for the ultra-low-priced samples changed more than the low priced samples. In turn, we hypothesize that consumers recognized that the discount at the ultra-low price was significant enough to change consumers perception of the product, but at the low price not enough of a discount is recognized by the consumer. On the other hand, Woodside and

Davenport (1976) observed that when pricing cleaning kits at a range of prices that consumers were more reluctant to purchase products at a very reduced price more so than at a slightly discounted price. Alternatively, Andreyeva et al. (2010) reported that consumers who are experiencing economic hardship are more likely to purchase the lowest cost item available to them in order to simply put food on the table. However, given the current times and the economic status reported by consumers in this study it is unlikely that consumers in the present study were experiencing economic hardships.

Primal source

Within the last decade, there has been a large increase in the amount of ground beef that has a primal blend source attached to it. Adding a primal source label to ground beef is meant to increase the appeal of the ground beef to consumers by adding a "premium" level to it. Moreover, adding a primal specific source also adds a level of complexity to the ground beef, especially when layered with other package and ground beef attributes (Savell and Gehring, 2020). To be labeled with a primal source, ground beef must be derived all or in part from the primal source to be used with exception of adding up to 6% shank meat for those being labeled as from the chuck or round (USDA, 2005). Furthermore, Ward et al. (2008) reported ground chuck to be purchased more frequently and at a higher price than commodity ground beef in an analysis of supermarket scanner data, indicating the popularity of primal specific blends. Of the three sources of information evaluated, adding the primal source blend had the greatest effect on consumer ratings in the current study. Despite consumers finding these differences, primal source was considered intermediate in terms of importance as consumers are purchasing ground beef. However, consumers clearly indicated a preference for labeling the ground beef with a primal source.

Much of the more recent research surrounding ground beef has been centered around primal specific blends (McHenry, 2013; Blackmon et al., 2015; Kerth et al., 2015; Beavers, 2017). However, conflicting results have been reported within these studies. When utilizing consumers, Beavers (2017) found consumers to prefer the flavor of ground round, ground sirloin, and commodity ground beef over the flavor of ground chuck, along with preferring the texture of commodity ground beef. Additionally, consumers in this study did not have a preference overall for the various blends and fat contents that were used (Beavers, 2017). Conversely, the only other study utilizing consumers was reported by Kerth et al. (2015), who found consumers to have no preference in the primal source of fat trimmings utilized in various ground beef blends. Yet, trained sensory panel have noted differences in blends from various primal sources including the brisket, chuck, plate, and round (McHenry, 2013; Blackmon et al., 2015; Kerth et al., 2015). Despite there being unclear advantages from any of the primal sources from a palatability standpoint, there has been a large push from both the retail and foodservice sector to develop and market a large array of primal blends. The present study demonstrated that despite their being few differences in the product quality, as is the case with the various primal blends, consumers showed a clear preference for the primal source blends in many of the traits evaluated. We propose that consumers are naturally drawn to the concept of their ground beef coming from a single source as it appeals to a more natural and higher quality product.

Conclusions

Ultimately, the labeling and marketing of a commodity product such as ground beef allows for product differentiation in the marketplace. Labeling the fat content and primal source does influence the consumers palatability experience, with the primal source label attaching an

increased perception of added quality to it. Furthermore, the price found on the product does impact the consumers eating experience with higher prices cueing the consumer to believe it has added taste benefits. Our results indicate that all the cues we use in marketing products at retail play a role in consumers perception of palatability. Those who are marketing and labeling products need to be mindful of the impact that prices, fat content and primal source have on the consumers eating experience.

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Table 2-1. Demographic characteristics of consumers (*N* = 315; 105 / panel type) who participated in ground beef consumer sensory panels with additional information provided about the fat content, price, or primal source

Characteristic	Response	Percentage of consumers		
		Fat Panel	Price Panel	Primal Panel
Gender	Male	49.5	36.7	60.6
	Female	50.5	63.3	39.4
Household size	1 person	14.1	13.5	21.0
	2 people	40.2	40.5	39.1
	3 people	21.8	14.6	15.2
	4 people	14.1	15.7	16.1
	5 people	8.7	11.2	7.6
	6 people	1.1	3.4	1.0
	Greater than 6 people	0.0	1.1	0.0
Marital Status	Married	70.6	73.9	66.4
	Single	29.4	26.1	33.6
Age	Under 20	2.2	0.0	1.0
	20-29	17.2	18.0	22.9
	30-39	15.0	18.0	20.0
	40-49	17.2	16.9	19.0
	50-59	26.9	24.7	15.2
	Over 60	21.5	22.4	21.9
Ethnic Origin	African American	0.0	0.0	2.9
	Asian	0.0	0.0	1.0
	Caucasian/White	97.9	98.9	78.1
	Hispanic	0.0	0.0	15.2
	Mixed Race	2.1	1.1	0.0
	Native-American	0.0	0.0	0.0
	Other	0.0	0.0	2.8
Income	Under $25,000	5.9	4.9	15.0
	$25,000-$34,999	4.7	7.3	11.0
	$35,000-$49,999	8.2	13.4	16.0
	$50,000-$74,999	29.4	25.6	16.0
	$75,000-$99,999	22.4	20.7	13.0
	$100,000-$149,999	12.9	15.9	18.0
	$150,000-$199,999	8.2	11.0	5.0
	Greater than $199,999	8.2	1.2	6.0
Education Level	Non-high school graduate	0.0	0.0	1.0
	High school graduate	27.2	22.7	4.8
	Some college/technical school	21.7	25.0	28.5
	College graduate	32.6	38.6	46.7
	Post-college graduate	18.5	13.6	19.0
Most important palatability trait when consuming ground beef	Tenderness	7.6	3.4	14.4
	Juiciness	20.7	15.7	16.3
	Flavor	68.5	75.3	63.5
	Texture	3.3	5.6	5.8
Preferred degree of doneness when consuming ground beef	Very rare	0.0	1.1	1.9
	Rare	4.3	0.0	3.8
	Medium rare	29.4	9.0	12.4
	Medium	27.2	30.3	18.1
	Medium well	23.9	34.9	28.5
	Well done	13.0	20.2	32.4
	Very well done	2.2	4.5	2.9
Weekly ground beef consumption	1 to 3 times	58.4	50.0	53.0
	4 to 6 times	31.7	35.7	30.3
	7 to 9 times	3.0	10.2	5.9
	10 or more times	6.9	4.1	10.8

Table 2-2. Ground beef purchasing motivators of consumers (*N* = 315; 105 / panel type) who participated in ground beef consumer sensory panels with additional information provided about the fat content, price, or primal source

Trait	Importance		
	Fat Panel	Price Panel	Primal Panel
Fat content	70.2[a]	69.5[abc]	72.2[a]
Animal welfare	68.9[ab]	69.7[abc]	60.1[bc]
Appearance – lean to fat ratio	68.8[ab]	71.6[ab]	67.3[ab]
Color	68.7[ab]	73.0[a]	66.3[ab]
Locally raised	66.4[abc]	61.9[cde]	52.8[c]
Nutrient content	61.1[bcd]	61.7[cde]	52.9[c]
Size, weight, and thickness	60.1[cd]	56.8[def]	60.4[bc]
Animal fed a grain-based diet	58.3[cde]	63.5[bcd]	56.3[c]
Price	57.3[de]	65.8[abc]	69.0[a]
Primal source	50.8[ef]	54.3[efg]	54.5[c]
Packaging type	45.3[fg]	52.8[fg]	38.3[de]
Brand of product	43.0[fg]	46.4[gh]	37.4[de]
Animal not administered antibiotics	41.0[g]	40.8[hi]	37.9[de]
Growth promotant use in the animal	40.9[g]	46.1[gh]	41.3[d]
Fresh never frozen	38.0[gh]	31.2[j]	43.4[d]
Pre-formed patty	37.3[gh]	32.8[ij]	30.7[e]
Animal fed a grass-based diet	30.0[ih]	37.2[ij]	37.8[de]
Natural or organic claims	28.4[i]	30.6[j]	31.7[e]
SE[2]	3.0	3.1	3.0
P-value	< 0.01	< 0.01	< 0.01

[abcdefghij] Least square means within the same panel lacking a common superscript differ ($P < 0.05$).

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

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

Table 2-3. Consumer (*N* = 315; 105 / panel type) palatability ratings[1] for ground beef patties when additional information was given about the fat content, price, or primal blend.

Treatment	Tenderness	Juiciness	Flavor Liking	Texture Liking	Overall Liking	Purchasing Intent
Fat Panel[2]						
90% Lean/10% Fat	60.4	58.9[c]	59.6	58.8	58.9	57.1
80% Lean/20% Fat	66.5	68.1[ab]	63.0	61.2	65.7	62.3
73% Lean/27% Fat	69.6	70.9[a]	65.5	62.0	64.7	62.3
Lean	63.4	65.9[abc]	58.6	60.7	60.5	58.0
Extra Lean	60.1	61.6[bc]	59.1	59.4	58.4	55.4
NONE[3]	63.3	66.7[ab]	58.1	59.9	60.1	57.0
SE[4]	2.6	2.7	2.7	2.7	2.7	3.1
P - value	0.09	0.02	0.25	0.96	0.29	0.49
Price Panel[5]						
Ultra-High	72.8	73.9[a]	68.6[a]	66.2	69.6	62.4
High	67.3	70.9[ab]	61.5[abc]	62.6	63.8	59.6
Medium	69.4	73.3[a]	66.3[ab]	64.7	68.8	66.8
Low	66.5	65.3[bc]	59.9[bc]	62.6	61.4	57.9
Ultra-Low	70.7	74.0[a]	63.9[abc]	64.7	65.0	61.1
NONE[3]	66.7	62.6[c]	56.5[c]	60.4	58.8	55.3
SE[4]	2.5	2.6	2.7	2.7	3.0	3.0
P - value	0.29	< 0.01	0.02	0.62	0.06	0.07
Primal Panel[6]						
Ground Chuck	72.3[a]	73.6[a]	65.9[ab]	70.3[a]	70.4[a]	70.2[a]
Ground Round	65.8[b]	69.9[ab]	61.0[bc]	64.2[bc]	64.3[ab]	63.2[bc]
Ground Sirloin	71.5[a]	73.9[a]	69.4[a]	69.7[ab]	70.1[a]	69.5[ab]
Store Ground	67.7[ab]	70.9[ab]	63.2[abc]	63.8[c]	65.4[a]	62.4[c]
NONE[3]	65.6[b]	65.8[b]	57.5[c]	59.1[c]	58.8[b]	56.9[c]
SE[4]	2.1	2.1	2.4	2.1	2.3	2.6
P - value	0.04	0.03	0.01	< 0.01	< 0.01	< 0.01

[abc] Least square means within the same panel type of the same column lacking a common superscript differ ($P < 0.05$)

[1] Sensory scores: 0 = not tender/juicy, dislike flavor/texture/overall extremely, or extremely unlikely to purchase; 50 = neither tender nor tough, juicy nor dry, neither like nor dislike flavor/texture/overall, or neither likely or unlikely; 100 = very tender/juicy, like flavor/texture/overall extremely, or extremely likely to purchase

[2] Additional information given about the fat and/or lean content of the sample provided to the consumer prior to sample evaluation.

[3] NONE – no information was provided.

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

[5] Additional information given about the price of the sample provided to the consumer prior to sample evaluation. Prices: Ultra-High - $13.78/kg; High - $11.02/kg; Medium - $8.27/kg; Low - $5.51/kg; Ultra-Low - $2.75/kg.

[6] Additional information given about the primal source of the sample provided to consumers prior to sample evaluation.

Table 2-4. Percentage of ground beef patties considered acceptable for tenderness, juiciness, flavor, texture, and overall liking by consumers (*N* = 315; 105 / panel group) when given additional information about the fat content, price, or primal source.

Treatment	Tenderness Acceptability	Juiciness Acceptability	Flavor Acceptability	Texture Acceptability	Overall Acceptability
Fat Panel[1]					
90% Lean/10% Fat	91.6[ab]	79.8[c]	82.7	89.1	83.8
80% Lean/20% Fat	96.3[a]	94.2[a]	90.3	93.7	93.4
73% Lean/27% Fat	91.6[ab]	91.4[ab]	88.5	89.1	85.7
Lean	88.7[abc]	86.5[abc]	81.7	84.4	83.8
Extra Lean	80.1[c]	81.7[bc]	83.7	85.3	79.0
NONE[2]	87.8[bc]	92.3[a]	84.6	83.5	84.8
SE[3]	4.0	3.9	3.7	4.0	4.0
P - value	0.02	0.01	0.46	0.23	0.15
Price Panel[4]					
Ultra-High	95.9	96.5[a]	92.8[ab]	88.1	92.9[ab]
High	94.2	95.8[ab]	84.4[bc]	89.0	92.0[ab]
Medium	95.9	97.2[a]	93.7[a]	92.8	93.8[a]
Low	90.7	89.3[bc]	81.5[c]	88.1	84.5[bc]
Ultra-Low	96.7	95.8[ab]	81.5[c]	90.0	88.3[abc]
NONE[2]	88.9	86.7[c]	77.7[c]	85.3	80.7[c]
SE[3]	3.5	4.2	4.5	3.7	4.3
P - value	0.11	< 0.01	< 0.01	0.67	0.03
Primal Panel[5]					
Ground Chuck	92.8	95.2	89.2	93.5	90.1
Ground Round	93.6	94.3	88.3	90.7	91.6
Ground Sirloin	95.3	96.2	91.1	88.8	92.5
Store Ground	92.8	93.3	84.6	88.8	90.7
NONE[2]	91.9	89.5	81.8	85.9	87.1
SE[3]	2.9	3.0	4.1	3.5	3.7
P - value	0.87	0.35	0.28	0.50	0.71

[abc] Least squares means within the same panel type of the same column lacking a common superscript differ ($P < 0.05$)

[1] Additional information given about the fat and/or lean content of the sample provided to the consumer prior to sample evaluation.

[2] NONE – no information was provided.

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

[4] Additional information given about the price of the sample provided to the consumer prior to sample evaluation. Prices: Ultra-High - $13.78/kg; High - $11.02/kg; Medium - $8.27/kg; Low - $5.51/kg; Ultra-Low - $2.75/kg.

[5] Additional information given about the primal source of the sample provided to consumers prior to sample evaluation.

Figure 2-1. Change in sensory scores due to lean point disclosure prior to sample evaluation. Fat treatments presented as the percentage lean/percentage fat. * Mean differs from zero ($P < 0.05$).

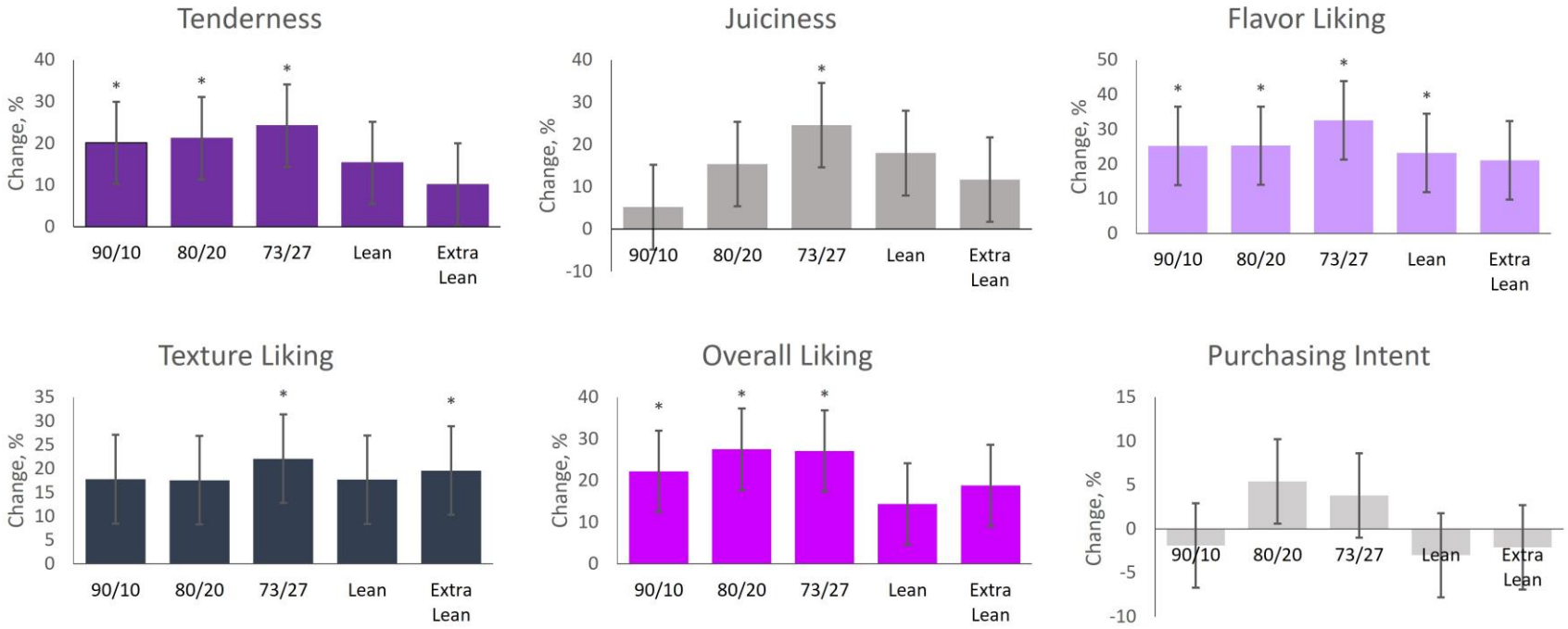


Figure 2-2. Change in sensory scores due to price being disclosed prior to sample evaluation. Prices: Ultra High - $13.78/kg; High - $11.02/kg; Medium - $8.27/kg; Low - $5.51/kg; Ultra Low - $2.75/kg. [ab] Least square means within the same trait lacking a common superscript differ ($P < 0.05$). * Mean differs from zero ($P < 0.05$).

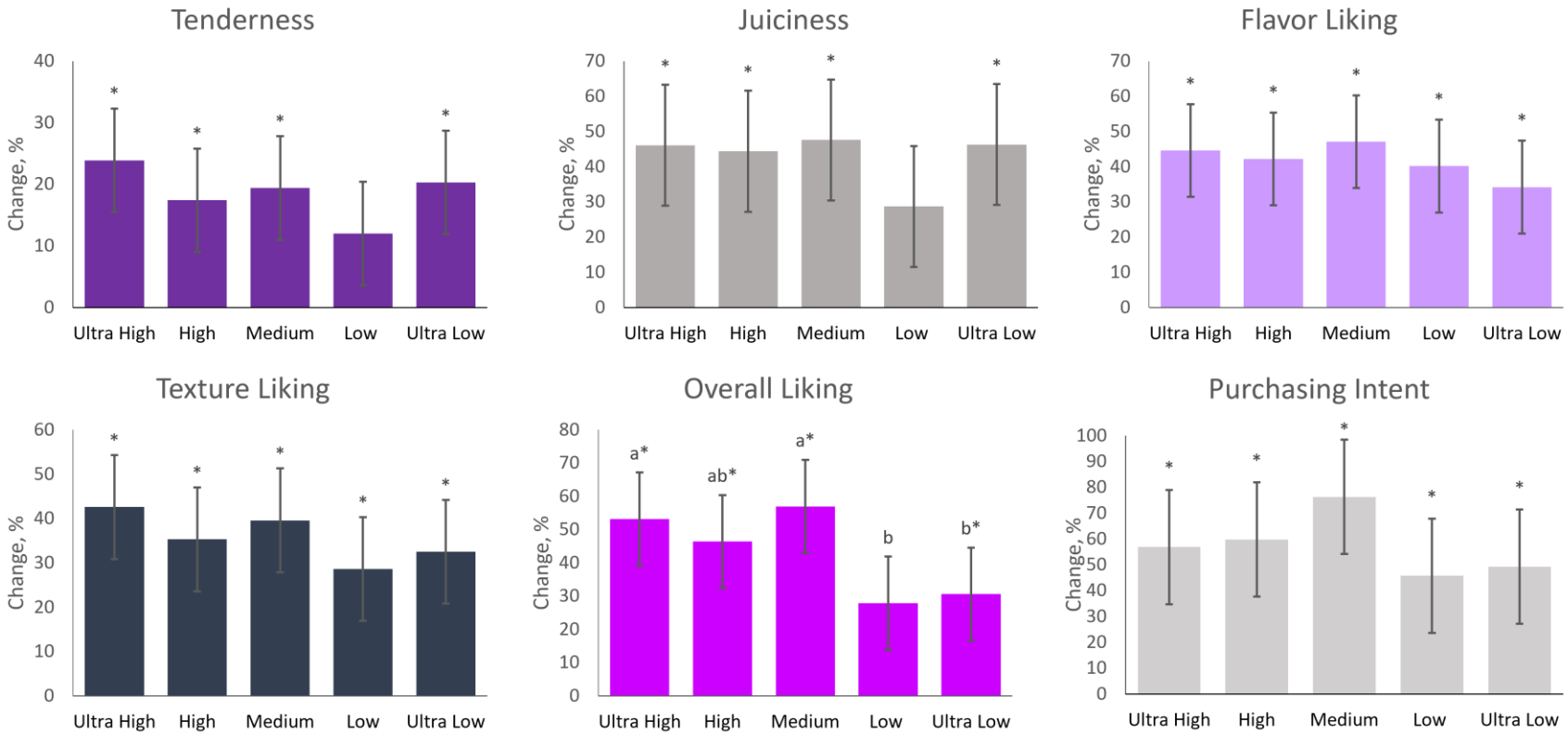


Figure 2-3. Change in sensory scores due to primal source being disclosed prior to sample evaluation. [ab] Least square means within the same trait lacking a common superscript differ ($P < 0.05$). * Mean differs from zero ($P < 0.05$).

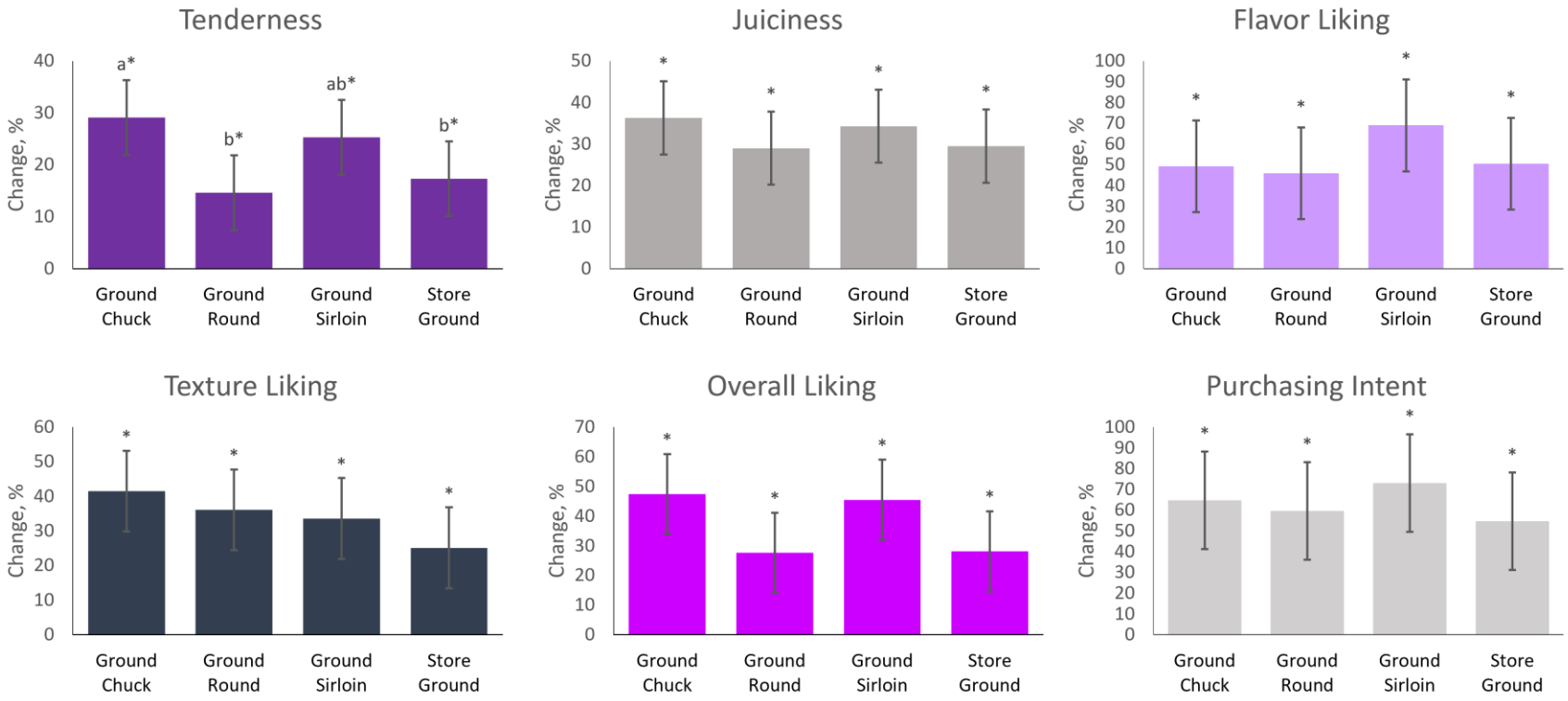


Figure 2-4. Change in the percentage of samples rated as acceptable by consumers due to lean content disclosure prior to sample evaluation. Fat content presented as percentage lean/percentage fat. [ab] Least square means within the same trait lacking a common superscript differ ($P < 0.05$). * Mean differs from zero ($P < 0.05$).

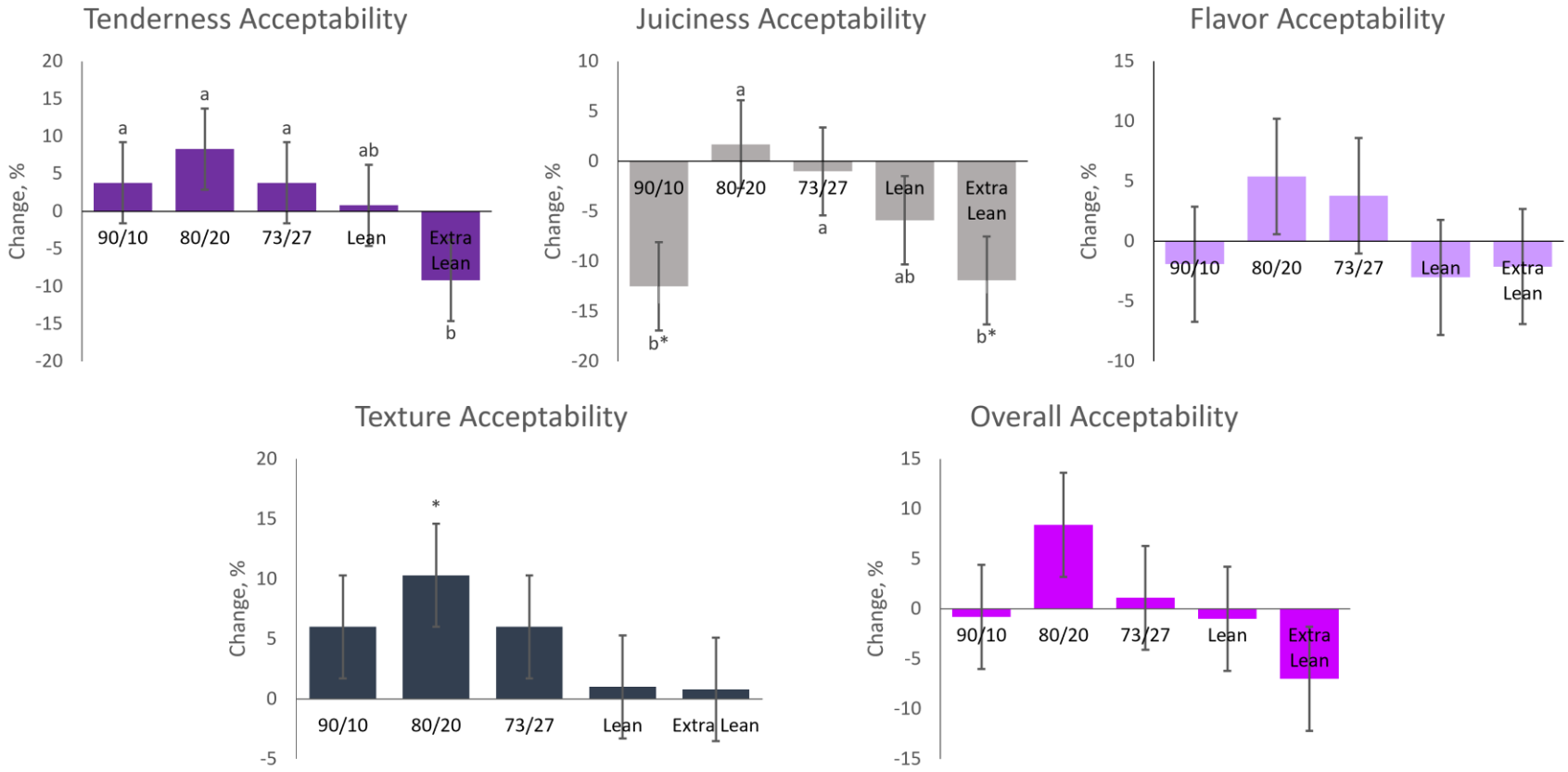


Figure 2-5. Change in the percentage of samples rated as acceptable by consumers due to price being disclosed prior to sample evaluation. Prices: Ultra High - $13.78/kg; High - $$11.02/kg; Medium - $8.27/kg; Low - $5.51/kg; Ultra Low - $2.75/kg. [abc] Least square means within the same trait lacking a common superscript differ ($P < 0.05$). * Mean differs from zero ($P < 0.05$).

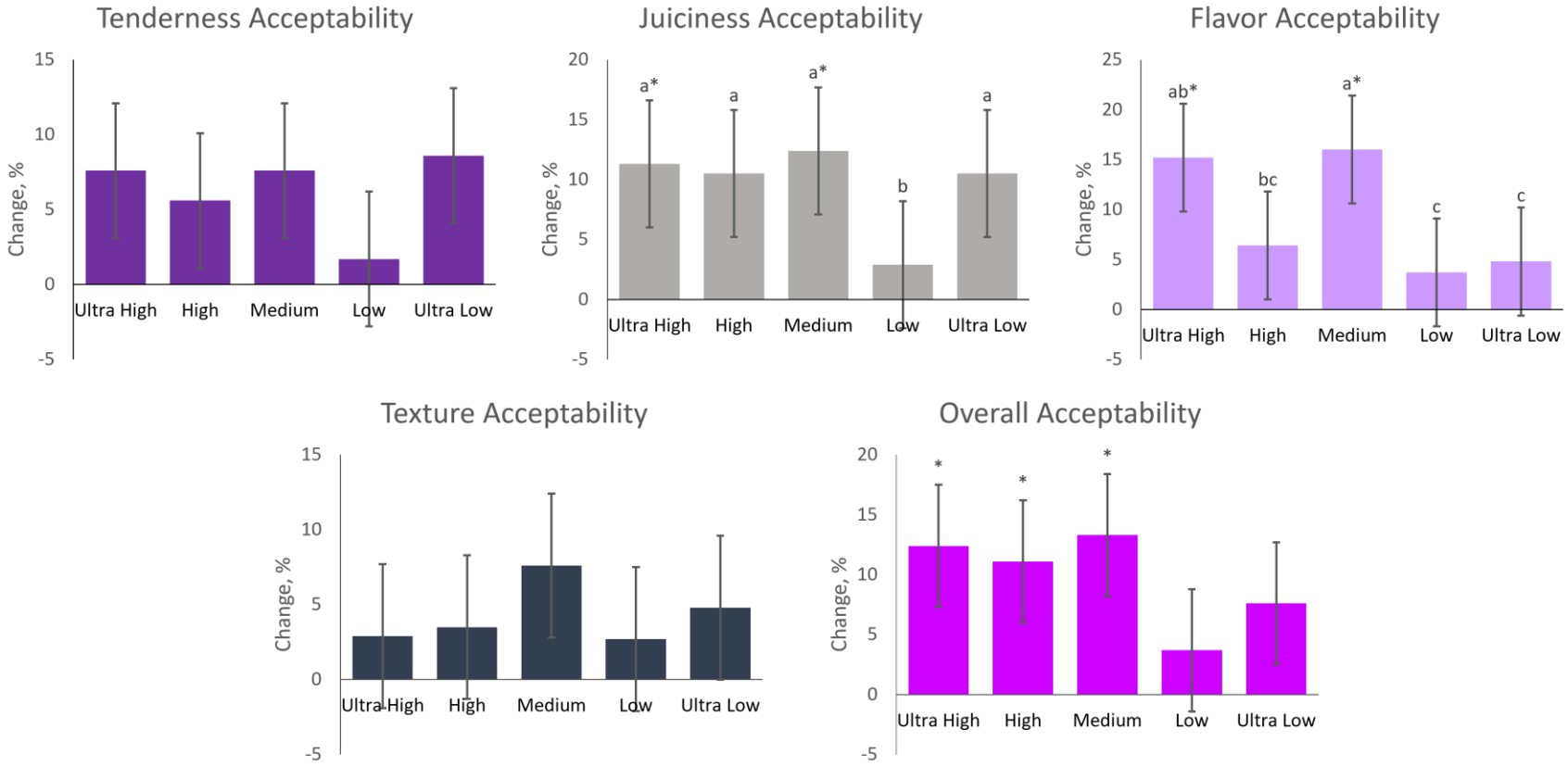
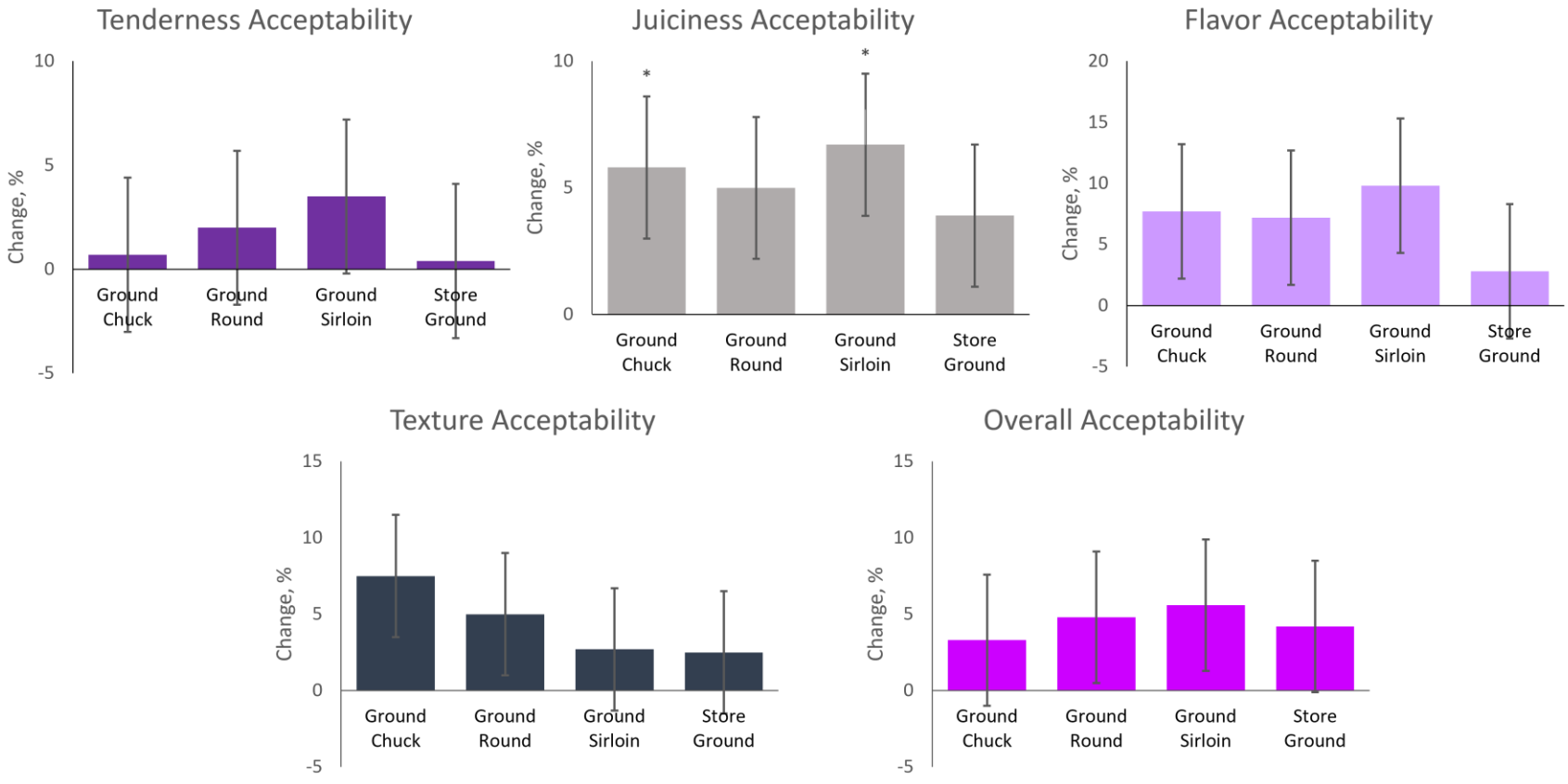


Figure 2-6. Change in the percentage of samples rated as acceptable by consumers due to primal source being disclosed prior to sample evaluation. * Mean differs from zero ($P < 0.05$).



Chapter 3 - Determination of the impact of labeling terms on consumer sensory evaluation

Abstract

The objective of this study was to evaluate consumers' palatability ratings of ground beef from the same source when provided information about the labeling prior to evaluation. Chubs (n = 15) from the same production lot and day of 80% lean / 20% fat ground beef were procured and fabricated into 151.2 g patties. Pairs of patties from each chub, which was randomly assigned to one consumer panel session, were randomly assigned to 1 of 8 different labeling terms: all natural, animal raised without added antibiotics (WA), animal raised without added hormones (WH), fresh never frozen (FNF), grass-fed, locally sourced, premium quality, USDA organic (ORG), and a blank sample (NONE). Consumers (N = 105) evaluated each sample on 0-to-100-point line scales for tenderness, juiciness, flavor liking, texture liking, overall liking and purchasing intent, as well as evaluated each palatability trait as either acceptable or unacceptable. Prior to sample evaluation, the consumers were provided additional labeling information about the ground beef. Consumers found no differences ($P > 0.05$) among the samples with the different labeling terms for tenderness, juiciness, texture liking, overall liking, tenderness acceptability, flavor acceptability, and texture acceptability for all the treatments evaluated. For flavor liking, there was a larger increase ($P < 0.05$) in ratings for samples labeled as grass-fed in comparison to WA, WH, and premium quality labeled samples. There was a large increase ($P < 0.05$) in the consumer ratings for overall liking when product was labeled as all natural, WA, WH, FNF, locally sourced, premium quality, and ORG. Additionally, there was a larger decrease ($P < 0.05$) in the percentage of samples rated as acceptable overall when labeled as WA in

comparison to all other treatments. These results indicate that adding production claims that consumers are familiar with can improve the palatability perception.

Key Words: branding, Ground Beef, labeling, palatability, consumer

Introduction

Purchasing food products at retail no longer involves simply finding the single commodity that is needed. Consumers are increasingly presented with multiple products that fall under numerous brands and labels. The brands and labels are the main form of communication that consumers receive from a product at the time of purchase (Nocella et al., 2010). Numerous cues can be found on the labels of meat items in the retail case and on menus in foodservice, which vary in being both intrinsic and extrinsic to the product. Consumers mainly evaluate a product based on the extrinsic cues available to them, however, the cues they use vary based on the type of meat they are purchasing (Aboah and Lees, 2020). The most recent National Meat Case Study found only 4% of packages to be unbranded in the retail case, which changed from the 2010 study which found 27% of packages to be unbranded (Kelly, 2016), further highlighting the increased branding and labeling of products currently to attract consumers at the retail case.

The impact of production practices on the palatability of food products has been extensively studied (Napolitano et al., 2010; Kumpulainen et al., 2018; Bir et al., 2020; Wemette et al., 2021). Several terms including “organic” and “locally sourced” have a perceived “halo” effect on food palatability traits, despite the lack of additional quality, taste, or nutritional benefits (Abrams et al., 2010; Bacig and Young, 2019; Gassler et al., 2019). However, few of these studies have involved meat, and none have been conducted in a false informed setting to evaluate the impact when labeling information is given. Bernués et al. (2003) found that consumers purchasing meat mainly focus on the extrinsic attributes around animal feeding,

animal origination, environmental friendliness, and animal welfare when purchasing meat at retail. Yet, limited data exists as to how U.S. consumers utilize this same information.

Consumers use a combination of intrinsic and extrinsic cues to predict and assess beef quality, as well as their predicted use of the product (McIlveen and Buchanan, 2001). Ron et al. (2019) demonstrated consumers are influenced in their perception of beef steak palatability when production practice and labeling information is known about the product prior to sample evaluation. Similarly, Wilfong et al. (2016a) and Wilfong et al. (2016b) found consumers to be influenced by brand, fat level and primal source when they were informed of the products attributes prior to testing. Alternatively, Samant and Seo (2016) found consumers positive perceptions of tenderness, juiciness, and flavor in chicken to be related to their increased understanding and trust in labeling claims. However, consumers in these studies evaluated products that represented the various production and quality traits evaluated, leaving the authors to only speculate as to how the impact of inherent quality differences among treatments impacted their results.

Consumer interest in a product is stimulated by the ability of a product to tell a story through its various attributes (Fenger et al., 2015). While the greatest element for determining consumers preference is still taste, brand packaging also has a strong effect on the consumers eating experience (Méndez et al., 2011). Consequently, a greater understanding of the impact of labeling and branding on telling the story to the consumer and their subsequent eating experience must be evaluated. Therefore, the objective of this study was to evaluate the effect of providing information via different labeling terms on consumers' palatability ratings of ground beef of an identical source.

Materials and Methods

The Institutional Review Board of Kansas State University approved the procedures outlined in this study as project number 7440.7 (February 2, 2021).

Ground beef preparation

Due to the objective of this study assessing the impact of labeling and branding terms, the research team laid out an experimental design aimed at keeping the product quality the same and changing only the labeling terms provided to the consumers. Treatment allotment was designed so that each consumer would be sampling 9 different samples that corresponded to a different labeling term even though the product quality and intrinsic attributes were identical. A single sample for each consumer was assigned no information so that a basis of having no labeling information associated with a product could be established.

80% lean / 20% fat ground beef chubs were acquired from the same production lot and production day from a commercial food purveyor. Chubs were shipped to the Kansas State University Meat Laboratory, Manhattan, KS and stored under refrigeration at 0-4°C before patty formation.

Eleven days after the date of manufacture, ground beef chubs (n = 15) were formed into 113.4 g patties (approximately 10 cm diameter, 1 cm thick) using a Hollymatic patty former (Super Model 54 Food Portioning Unit, Countryside, IL). To keep patties as similar to one another as possible, chubs were randomly assigned to one single panel session. Patties were randomly labeled in the order in which they were formed, and patties were kept as pairs. Two pairs of patties were designated for instrumental tenderness testing and texture profile analysis **(TPA)**. The remaining patties were designated and labeled for consumer sensory testing as: all natural, animal raised without added antibiotics **(WA)**, animal raised without added hormones

(WH), fresh never frozen **(FNF)**, grass-fed, locally sourced, premium quality, USDA organic **(ORG)**, and a blank sample **(NONE)**. After fabrication, patties were crust frozen for approximately 30 min and then packaged on a rollstock type packaging machine (Model Bulldog 42a300, Ultrasource, Kansas City, MO). All samples were frozen until analysis at -40°C.

Instrumental tenderness testing for shear force was performed according to the procedures set by the American Meat Science Association (**AMSA**) for ground beef patties (AMSA, 2015). Texture profile analysis was done utilizing the procedures described by Bourne (1978).

Consumer sensory evaluation

Prior to cooking for each panel, patties were thawed for 20 to 24 h at 2 to 4°C. Cooking was conducted on Cuisinart Griddler Deluxe (East Windsor, NJ) clam-shell style grills that were set at 177°C. The peak temperature of 71°C was targeted and recorded using a Doric 205 (Beckman Industries, Newbury Park, CA) thermocouple type thermometer inserted into the geometric center of the patties while cooking. Using a cutting guide, patties were sliced into 6 equally sized triangular pieces once they were cooked, placed on plates, and immediately served to consumers who were pre-determined.

Recruitment for consumer panelists (n = 105) took place in the Manhattan, KS and surrounding areas. All consumers were compensated monetarily for completing a full panel session. Consumers were fed in a lecture-style classroom on Kansas State University under normal fluorescent lighting in panel sessions that lasted approximately 1 h. Five different panel sessions consisting of 21 consumers were held. Each panelist was given a cup of water, apple juice, and unsalted crackers to use as palate cleansers in between each sample, along with a napkin, plastic fork, and an empty expectorant cup. Consumers were informed and given verbal

instructions about the evaluation procedures, palate cleansing, and digital survey use prior to evaluating any samples.

The labeling information associated with each treatment was provided to consumers prior to their evaluation of each sample. Information was displayed on a screen in the front of the classroom and said aloud to consumers as samples were being served. The feed order for each session was predetermined and in a randomized order. When consumers were served the NONE sample, a blank screen appeared, and they were informed they were eating a sample of ground beef with no other information provided about the sample. Consumers were asked to consider the additional labeling information as they were consuming the ground beef and utilize it in their evaluation of each sample.

Digital surveys (Qualtrics XM, Provo, UT) were preloaded onto electronic tablets (Lenovo TB-8505F) for consumers to complete during their evaluation of samples. First, consumers were asked to voluntarily give some demographic information about themselves which included asking about their gender, marital status, household size, ethnicity, income, level of education, weekly ground beef consumption, their preferred degree of doneness when consuming ground beef, and the palatability trait most important to them when consuming ground beef. Next, a series of purchasing motivator questions were asked that had the consumer rate the importance of each trait on 0 to 100-point line scales verbally anchored at either ends with 0 = extremely unimportant, and 100 = extremely important. As consumers evaluated the 9 different samples, they were asked to rate the tenderness, juiciness, flavor liking, texture, and overall liking as well as give their likeliness to purchase each sample. Ratings were recorded on 0-to-100-point line scales which were anchored at each end and at the center: 0 = extremely dry, tough, dislike flavor/texture/overall extremely, and extremely unlikely; 50 = neither juicy nor

dry, neither tough nor tender, neither like nor dislike, and neither likely nor unlikely; and 100 = extremely juicy, tender, like flavor/texture/overall extremely, and extremely likely. Finally, each trait was rated as either acceptable or unacceptable by consumers.

Change in rating determination

The change in palatability ratings as an impact of labeling was calculated for each sample's change in palatability ratings and purchasing intent in order to assess the changes in consumers' perceptions of the samples when information was provided. Change in palatability scores was calculated by subtracting the consumer's rating for the NONE sample from the rating for the labeled sample and dividing by the rating for the NONE sample and is presented as a percentage.

Statistical analysis

The statistical analysis software of SAS (SAS Institute Inc., Cary, NC) utilizing the PROC GLIMMIX procedure was used for all statistical analysis. An α value of 0.05 was considered significant for the comparison of treatments. A completely randomized design was utilized with a Kenward-Roger adjustment for all analyses. Panel session was considered as a random effect for all sensory evaluation data. Additionally, a binomial error distribution was used for the consumer acceptability data model.

Results

Demographic characteristics and purchasing motivators

Information about the demographics of participants can be found in Table 3-1. The gender of the 105 participants was split almost evenly with females making up the majority (51.4%) of consumers. Most participants in the study were married (60.6%), Caucasian (87.5%), from a 2-person household (43.3%), and were a college graduate (35.6%). Moreover, the

majority of participants were over 30 years old, with 21.1% of the participants being 50 to 59 years old. More than half of the participants made greater than $50,000 annually and 12.7% made more than $100,000. Flavor (68.3%) was identified by the majority of participants as being the most important palatability trait when they consumer ground beef, followed by tenderness (15.3%), juiciness (13.5%), and texture (2.9%). Additionally, most participants preferred their ground beef cooked to medium-rare (28.9%), medium (21.1%), or medium-well (27.9%) degree of doneness. Furthermore, 77.2% of participants consumed ground beef 1 to 3 times per week.

Consumers were asked to rate the importance of 18 different traits considered when they are purchasing ground beef at retail (Table 3-2). Consumers rated "price" and "appearance – lean to fat ratio" similar ($P > 0.05$) in importance to "fat content" and "color", but more ($P < 0.05$) important than all other traits evaluated. Moreover, "animal welfare" was rated as more ($P < 0.05$) important than "fresh never frozen", "animal not administered antibiotics", "locally raised", "growth promotant use in the animal", "animal fed a grass-based diet", "natural or organic claims", and "animal fed a grain-based diet". "Animal not administered antibiotics" was similar ($P > 0.05$) in importance to "growth promotant use in the animal". Additionally, "animal fed a grain-based diet", "animal fed a grass-based diet", and "natural or organic claims" were rated similar ($P > 0.05$) in importance by consumers. Furthermore, "pre-formed patty" was similar ($P > 0.05$) in importance to "brand of product", but less ($P < 0.05$) important when compared to all other traits.

Sensory evaluation

The means of the consumer ratings for the palatability traits can be found in Table 3-3. Few differences were found among the treatments for the palatability traits evaluated by consumers. When evaluating flavor liking, consumers rated locally sourced labeled ground beef

higher ($P < 0.05$) for flavor than WA, premium quality labeled samples, and NONE, but similar ($P > 0.05$) to all other treatments. Moreover, WA was rated lower ($P < 0.05$) for flavor liking than all natural, grass-fed, locally sourced, and organic labeled ground beef, but similar ($P > 0.05$) to all other treatments. There were no differences ($P > 0.05$) in the consumer ratings for tenderness, juiciness, texture liking and overall liking among all the treatments. Consumers were also asked to give their likelihood to purchase each of the samples. The NONE sample with no information provided was rated lower ($P < 0.05$) for purchasing intent than all natural, grass-fed, locally sourced, and ORG labeled products. Furthermore, WH was similar ($P > 0.05$) to all other treatments for consumers intent to purchase.

To account for the changes in consumer ratings when information was provided, the change in consumer palatability traits was calculated [(consumer trait score – NONE score) / NONE score] and reported in Figure 3-1. For tenderness, large increases ($P < 0.05$) in tenderness ratings for all natural (25.0%), grass-fed (23.4%), and locally sourced (20.7%) labeled ground beef were observed when information was provided. Similar increases ($P < 0.05$) were also found for juiciness, in which ratings for WH (24.5%), grass-fed (23.0%), locally sourced (20.7%), premium quality (20.9%), and ORG (24.0%) labeled products increased when information was given to consumers. Grass-fed labeled samples had a larger ($P < 0.05$) increase in flavor liking ratings when information was provided in comparison to WA, WH, and premium quality labeled samples, but had a similar ($P > 0.05$) change in ratings as all natural, FNF, locally sourced, and ORG labeled samples. Large increases ($P < 0.05$) for texture liking were found when consumers were informed that a product was labeled as all natural (30.6%), WH (44.0%), grass-fed (36.1%), and locally sourced (33.8%). Again, a large increase ($P < 0.05$) in overall liking ratings were observed for all natural (30.1%), WA (28.6%), WH (29.8%), FNF (39.0%),

locally sourced (34.9%), premium quality (28.9%), and ORG (30.0%) when consumers were informed of the labeling information. Purchasing intent ratings also increased ($P < 0.05$) for all terms except for premium quality when additional labeling information was provided.

Palatability trait acceptability

Consumers were asked to rate each palatability trait as either acceptable or unacceptable during their evaluation of each sample of ground beef (Table 3-4). There were no differences ($P > 0.05$) among treatments in the percentage of samples rated as acceptable for tenderness, flavor, and texture, with more than 70% of the samples rated as acceptable for each trait. For juiciness acceptability, WA had a lower ($P < 0.05$) percentage of samples rated as acceptable in comparison to all natural, WH, FNF, locally sourced, premium quality and organic labeled products, but was similar ($P > 0.05$) to grass-fed and NONE. Furthermore, locally sourced labeled ground beef had a higher ($P < 0.05$) percentage of samples rated as acceptable overall in comparison to NONE, and WA, but was similar ($P > 0.05$) to all other treatments. Also, WA had the lowest ($P < 0.05$) percentage of samples rated as acceptable overall, being similar ($P > 0.05$) only to NONE.

The change is acceptability ratings when information was provided versus the NONE sample was calculated and can be found in Figure 3-2. For tenderness there was an increase ($P < 0.05$) in the percentage of samples rated as acceptable by consumers when ground beef was labeled as all natural (10.5%), grass-fed (10.5%), locally sourced (9.5%), and premium quality (9.5%). Conversely, there was a larger ($P < 0.05$) decrease in the percentage of samples rated acceptable for juiciness when ground beef was labeled as WA in comparison to all other treatments. The same trend was observed for flavor acceptability, as labeling WA decreased ($P < 0.05$) the percentage of samples rated as acceptable when the treatment information was

disclosed. All natural and organic labeling increased ($P < 0.05$) the percentage of samples rated as acceptable for texture. Furthermore, the percentage of samples rated as acceptable overall increased ($P < 0.05$) for all treatments when production information was disclosed, with the exception of WA which decreased ($P < 0.05$) in the percentage of samples rated as acceptable overall.

Shear force and TPA analysis

One sample from each chub of ground beef was utilized for shear force and TPA analysis. An average shear force value of 2.68 kg ± 0.21 of force was determined for the 15 chubs. For TPA, the averages ± standard deviation were reported and are as follows: hardness – 12.22 ± 2.17; cohesiveness – 0.38 ± 0.02; gumminess – 4.68 ± 0.99; springiness – 72.58 ± 3.25; and chewiness – 3.43 ± 0.84.

Discussion

Numerous intrinsic cues about a product are balanced with extrinsic cues within labeling and branding strategies surrounding a product as consumers purchase food products at retail and foodservice (McIlveen and Buchanan, 2001). The main form of communication for meat products comes from cues found on the package and any additional marketing materials present at the time of purchase (Nocella et al., 2010). Increasing consumers' knowledge of a product is ultimately affected by the advertising of a brand or trait that is meant to stimulate interest of a product (Skipper et al., 1999). To increase consumer interest, a product needs to tell a story through the attributes that appeal to the more natural or authentic side (Fenger et al., 2015). In the current study, the utilization of terms that aid in telling the story of the product were selected based on ground beef labels currently found at retail. Furthermore, the most recent National Meat Case Study from 2015 reported only 4% of products are unbranded at the retail case indicating

the vast number of branding strategies used by companies (Kelly, 2016). The rise in popularity of branded products at retail has accordingly promoted an increase of information for consumers to evaluate.

Within the current study, labeling ground beef as locally sourced increased the consumers ratings across the palatability traits evaluated. Undoubtedly, the global events of 2020 and 2021 have garnered much attention to locally sourced food stuffs given challenges within the supply chain and consumers eating more meals from home (Ijaz et al., 2021). The current study was conducted in the fall of 2020, at the height of the COVID-19 pandemic, in which shortages of staple food items were prevalent and many consumers turned to more local sources to find meat and produce items, undoubtedly impacting consumers' perceptions of this term. Previous research while not involving meat specifically, found consumers of locally sourced food to view it as healthier, more nutritious, environmentally friendly, and more likely to be from an organic or natural origin (Bacig and Young, 2019). Numerous authors point to their being a perceived quality enhancing "halo" around products that are locally sourced, and thus increasing consumer liking of those products (Khachatryan et al., 2018; Kumpulainen et al., 2018; Bacig and Young, 2019). However, what is defined as local varies greatly by the region and the consumer (Martinez et al., 2010). Local is defined in some USDA programs as being a product that is less than 400 miles from the origination of production, however, there is no official USDA designation for local (Tropp, 2015). For our study, the samples were only identified as being locally sourced with no further information given, leaving it to the consumer for interpretation of the meaning of "local". Furthermore, consumers in the current study identified "locally raised" as being similar in importance to several other animal production claims when asked to rank the

importance of traits as they are purchasing ground beef at retail, however, locally sourced increased consumer ratings more so than other traits that were rated as higher in importance.

Labeling ground beef as from an animal raised without added antibiotics tended to have a negative perception and decreased the percentage of samples rated as acceptable for both flavor and overall. Within the literature, authors report varying reasons for consumers choosing to purchase products that are labeled as being antibiotic free (Bir et al., 2020; Wemette et al., 2021). Bir et al. (2020) found consumers willing to pay more for a USDA or industry verified antibiotic use free product when purchasing cheese. Conversely, Wemette et al. (2021) found consumers had a conviction that animal antibiotic usage posed a risk to their health when they are purchasing milk from cattle raised with the usage of antibiotics. The Food Safety and Inspection Service **(FSIS)** arm of the USDA, which governs labeling, only has the authority to ensure labeling is truthful and accurate and does not have any authority over animal production claims (FSIS, 2019). Therefore, attaching a raised without added antibiotics claim can be done with minimal documentation and carries little to no credence is some cases where antibiotic usage is not permitted. Consumers in the present study were more concerned with animal welfare and antibiotic usage labeling than the other production claims evaluated in their initial assessment of the purchasing motivators. Yet, the traits they rated similar to or lower than the antibiotic usage trait had a larger perceived effect on the palatability traits evaluated when samples were evaluated.

In the current study, labeling ground beef as grass-fed increased consumer palatability ratings for all traits except for overall liking. Previous studies evaluating grass fed beef, when quality differences existed, have found many consumers to be varying in their opinion of the flavor and overall liking of grass-fed beef compared to conventionally raised beef (Najar-

Villarreal et al., 2019; Ron et al., 2019). Ron et al. (2019) found increases in palatability ratings for grass-fed steaks in comparison to steaks from other production practices, including increases in overall liking due to the product being labeled as grass-fed. Najar-Villarreal et al. (2019) found differing results in a blinded study with consumers having a greater dislike overall for grass-fed beef over conventional beef. Conversely, Ellison et al. (2017) when evaluating multiple production claims found consumers to be less worried with grass-fed labeling compared to other production claims. FSIS governs the labeling of grass-fed products, which must be backed up by production records that maintain an animal must be fed only with grass or forage prior to slaughter (FSIS, 2019). Moreover, grass-fed beef products made up 97 million pounds of beef sold at retail in 2020, indicating the popularity of grass-fed products to consumers (Beef Checkoff, 2021). Grass-fed beef tends to come with the perception of having health benefits that consumers are willing to pay a premium for (Umberger et al., 2009; Carabante et al., 2018). Within the current study, consumers also indicated an increased willingness to purchase grass-fed beef in comparison to the other treatments.

Often sorted into the same category as grass-fed by consumers are the labels of all-natural and organic. In both cases, a clear definition for what a product must be for such labeling is well defined by the USDA-FSIS. For a product to be labeled as all-natural, it cannot have any enhancements or processing beyond the natural state, except for grinding or separating of whole, intact products (USDA, 2005). Conversely, to be labeled as USDA Organic a product must be verified by a third-party auditor to be following the organic practices and regulations set forth by USDA in accordance with the Organic Foods Production Act of 1990 (USDA, 2021). In the current study, a similar effect for both all-natural and organic labeling was observed with both have a large impact on consumer ratings. One possible explanation for this was reported by

Abrams et al. (2010) who found many consumers to consider many of the USDA organic standards in their perception of all-natural thus considered the all-natural label to be misleading. Two separate studies involving wine found consumers willing to pay a premium for natural and organically labeled wine (Galati et al., 2019; Gassler et al., 2019). Furthermore, Van Loo et al. (2010) found many consumers to view organic as being safer and healthier than conventionally raised product. Dominick et al. (2018) found similar views from consumers evaluating all-natural labeling and reported a perceived healthy "halo" around all-natural labeling. While separate in identity, consumers commonly confuse the meaning and perceptions behind natural and organic labeling which explains, in the case of our study, why consumers perceived the natural and organic labeled product as being similar to one another.

Of the claims evaluated by consumers, premium quality is the only cue to not have a specification to be labeled as such by FSIS (USDA-FSIS, 2020). In recent years, "premium quality" has been employed on package labels to attract consumer attention. Labels indicating a perceived quality level influence the consumer at the time of purchasing when multiple products of similar type are present (Meyerding et al., 2018). Therefore, attaching a statement such as "premium quality" is meant to attract a consumer looking for an item that has a higher quality cue attached. However, in the current study consumers indicated they were less likely to purchase the premium quality product. Attaching the premium quality label to products allows for a large degree of interpretation by the consumer and consumers who are not looking for an added level of quality might not receive a product marketed as such as well as those who are seeking an added level of quality. Thus, unlike many of the other labeling terms evaluated, premium quality labeling may not be as impactful on consumers' perceptions of eating quality.

Fresh never frozen was one of two cues used that was intrinsic in nature to the product. In order to be labeled as fresh, a product must not have been exposed to temperatures below -2°C and is not altered beyond the fresh state (USDA, 2005). Labeling ground beef as fresh never frozen had an impact on the overall liking, purchasing intent, and overall acceptability, but otherwise was a term considered intermediate in impact. Limited research exists as to U.S. based consumers perception of frozen ground beef product, despite their being offerings of frozen ground beef patties at retail. The popularity of fresh never frozen terminology has been largely used in foodservice chains, but not as extensively in retail. Though, Chinese consumers who evaluated frozen versus fresh pork indicated they would discount frozen product for not being as fresh (Wang et al., 2018).

Studying the impact of branding and labeling on meat products and its subsequent effect on palatability has proven to be challenging and limited in quantity. Previous research evaluating the branding of beef products effect on palatability has been conducted on both steaks and ground beef (Wilfong et al., 2016a, 2016b; Ron et al., 2019). However, these studies were conducted in manners in which actual product differences existed with the exception of Ron et al. (2019). Ron et al. (2019) did falsely inform consumers of the production practices utilized and found increases in consumer ratings of products of differing production claims despite there being no differences in product quality. Comparatively, within the current study, we also found increases in consumer ratings despite their being no differences in the ground beef being consumed. Overall liking and purchasing intent ratings were impacted the most due to labeling, indicating that the impact of labeling influences the overall perception of a product to a larger degree than the individual palatability traits. On the other hand, when evaluating chicken Samant and Seo (2016) found consumers who have a higher label understanding had an increased

perception of the tenderness, juiciness, and flavor of chicken breast than those who had a low understanding and trust in the labeling claims. Alternatively, Wilfong et al. (2016b) found an increase in ratings due to informing consumers of the production practice information (Certified Angus Beef) associated with the product being consumed. In that study, a "brand lift" was observed when attaching an additional brand and label to the products being evaluated (Wilfong et al., 2016b). However, the actual product quality differences in their study were present and quantifying the amount of the increased ratings that were attributed directly to the brand disclosure itself is difficult. Our study did not disclose any brand names but did include terms that aid in telling the story of a product and consequently increasing the marketability of a product.

Ultimately, labeling ground beef with various cues aids in telling the story of the product and creating product differentiation in the marketplace. Our study demonstrated that informing consumers of branding information creates a "brand lift", despite there being no differences in product quality. Adding production claims that the consumer is familiar with, and value can lead to improved palatability perceptions.

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Table 3-1. Demographic characteristics of consumers (*N*=105) who participated in ground beef consumer sensory panels when given additional labeling information.

Characteristic	Response	Percentage of Consumers
Gender	Male	48.6
	Female	51.4
Household size	1 person	20.2
	2 people	43.3
	3 people	20.1
	4 people	4.8
	5 people	4.8
	6 people	5.8
	Greater than 6 people	1.0
Marital Status	Married	60.6
	Single	39.4
Age	Under 20	6.7
	20-29	28.9
	30-39	14.4
	40-49	13.5
	50-59	21.1
	Over 60	15.4
Ethnic Origin	African American	2.9
	Caucasian/White	87.5
	Hispanic	6.7
	Mixed Race	2.9
Income	Under $25,000	12.8
	$25,000-$34,999	10.8
	$35,000-$49,999	17.6
	$50,000-$74,999	15.7
	$75,000-$99,999	13.7
	$100,000-$149,999	16.7
	$150,000-$199,999	8.8
	Greater than $199,999	3.9
Education Level	Non-high school graduate	2.9
	High school graduate	19.2
	Some college/technical school	24.0
	College graduate	35.6
	Post-college graduate	18.3
Most important palatability trait when consuming ground beef	Tenderness	15.3
	Juiciness	13.5
	Flavor	68.3
	Texture	2.9
Preferred degree of doneness when consuming ground beef	Rare	1.0
	Medium rare	28.9
	Medium	21.1
	Medium well	27.9
	Well done	16.3
	Very well done	4.8
Weekly ground beef consumption	1 to 3 times	77.2
	4 to 6 times	18.8
	7 to 9 times	2.0
	10 or more times	2.0

Table 3-2.Ground beef purchasing motivators[1] of consumers (*N* = 105) who participated in ground beef consumer sensory panels when given additional labeling information.

Trait	Importance
Appearance – lean to fat ratio	73.5[a]
Price	73.5[a]
Fat content	70.4[ab]
Color	65.8[abc]
Animal welfare	64.0[bc]
Size, weight, and thickness	58.0[dc]
Nutrient content	57.8[cd]
Primal source	52.8[de]
Fresh never frozen	46.5[ef]
Animal not administered antibiotics	45.6[ef]
Locally raised	45.2[ef]
Growth promotant use in the animal	42.9[f]
Animal fed a grass-based diet	40.9[fg]
Natural or organic claims	40.0[fg]
Animal fed a grain-based diet	39.0[fg]
Packaging type	38.5[fg]
Brand of product	33.3[gh]
Pre-formed patty	28.8[h]
SE[2]	2.9
P-value	< 0.01

[abcdefgh] Least square means within the same panel lacking a common superscript differ ($P < 0.05$).

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

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

Table 3-3. Consumer (*N* = 105) palatability ratings[1] for ground beef patties when given additional labeling information.

Term[2]	Tenderness	Juiciness	Flavor Liking	Texture Liking	Overall Liking	Purchasing Intent
All Natural	72.2	70.1	66.7^{ab}	67.8	67.0	66.0^{a}
Animal raised without added antibiotics.	65.1	62.5	59.4^{d}	64.3	60.9	55.4^{d}
Animal raised without added hormones.	67.6	68.9	64.3^{abcd}	66.5	65.3	61.6^{abcd}
Fresh never frozen	67.3	71.0	64.1^{abcd}	64.2	67.3	63.4^{abc}
Grass-fed	72.1	71.0	66.5^{ab}	69.0	69.0	65.9^{a}
Locally sourced	69.6	70.8	68.0^{a}	67.0	68.3	65.7^{ab}
Premium quality	68.5	71.5	60.9^{cd}	64.1	63.8	59.3^{bcd}
USDA Organic	70.3	70.9	65.9^{abc}	68.5	69.4	65.9^{a}
NONE[3]	66.5	67.2	62.0^{bcd}	63.2	62.8	58.6^{cd}
SE[4]	2.5	2.7	2.6	2.3	2.9	3.2
P - value	0.14	0.18	0.03	0.12	0.08	< 0.01

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

[1] Sensory scores: 0 = not tender/juicy, dislike flavor/texture/overall extremely, or extremely unlikely to purchase; 50 = neither tender nor tough, juicy nor dry, neither like nor dislike flavor/texture/overall, or neither likely or unlikely; 100 = very tender/juicy, like flavor/texture/overall extremely, or extremely likely to purchase

[2] Labeling terms and information provided to consumers prior to sample evaluation.

[3] Blank – no information was provided.

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

Table 3-4. Percentage of ground beef patties considered acceptable for tenderness, juiciness, flavor, texture, and overall liking by consumers (*N* = 105) when given additional labeling information.

Term[1]	Tenderness Acceptability	Juiciness Acceptability	Flavor Acceptability	Texture Acceptability	Overall Acceptability
All Natural	96.0	91.2[a]	90.0	93.9	91.4[ab]
Animal raised without added antibiotics.	91.0	80.1[b]	78.9	87.5	74.5[c]
Animal raised without added hormones.	90.0	94.0[a]	85.5	90.3	85.9[ab]
Fresh never frozen	90.0	91.3[a]	84.6	87.5	90.5[ab]
Grass-fed	96.0	87.6[ab]	88.2	92.1	89.6[ab]
Locally sourced	95.2	92.2[a]	90.0	92.1	92.3[a]
Premium quality	95.2	93.1[a]	86.4	90.3	91.4[ab]
USDA Organic	93.5	94.0[a]	90.0	94.8	90.5[ab]
NONE[2]	86.5	88.6[ab]	86.4	83.8	83.1[bc]
SE[3]	3.9	4.4	4.9	3.9	5.0
P - value	0.08	0.03	0.33	0.19	< 0.01

[abc] Least square means within the same column lacking a common superscript differ ($P < 0.05$).

[1] Labeling terms and information provided to consumers prior to sample evaluation.

[2] Blank – no information was provided.

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

Figure 3-1. Change in sensory scores due to labeling information disclosure prior to sample evaluation. [abcd] Least square means within the same trait lacking a common superscript differ ($P < 0.05$) * Mean differs from zero ($P < 0.05$).

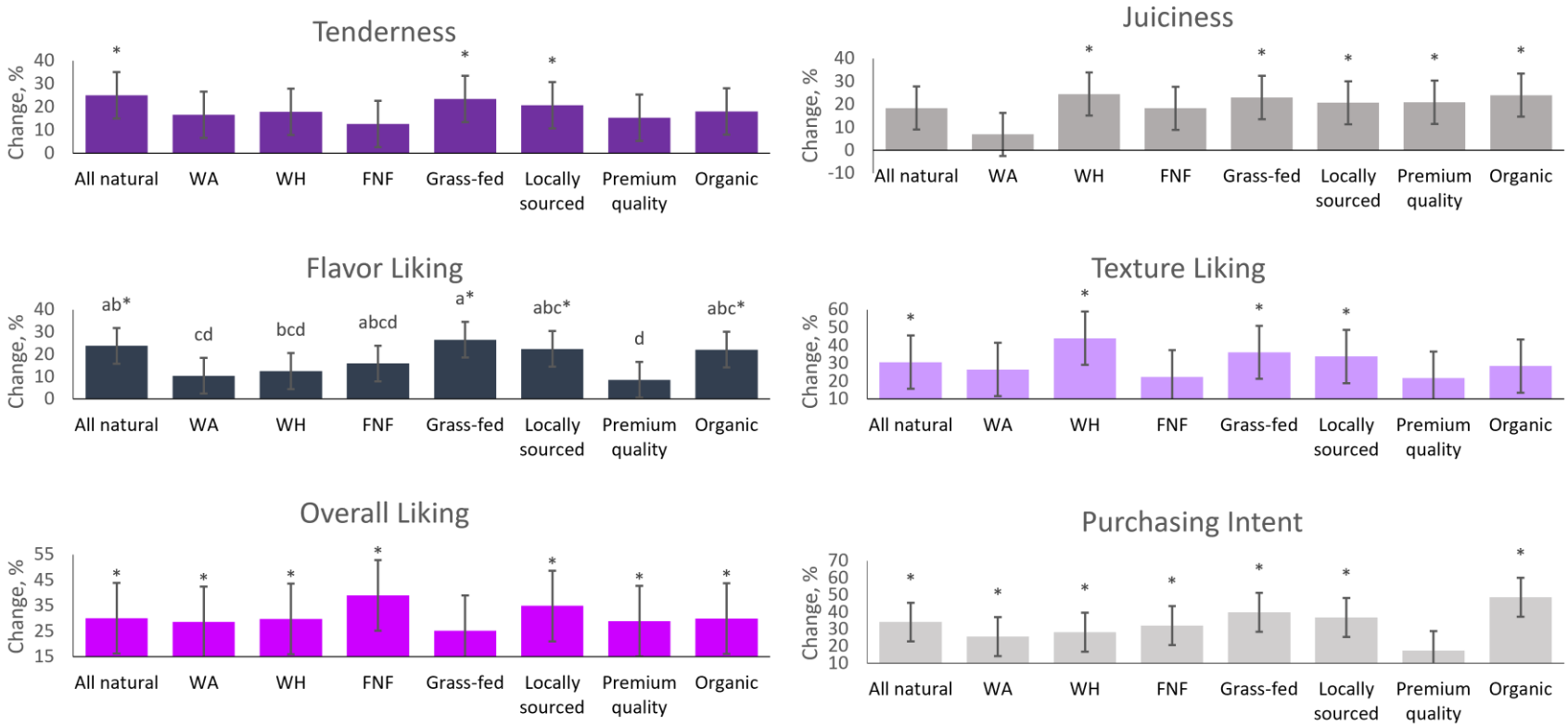
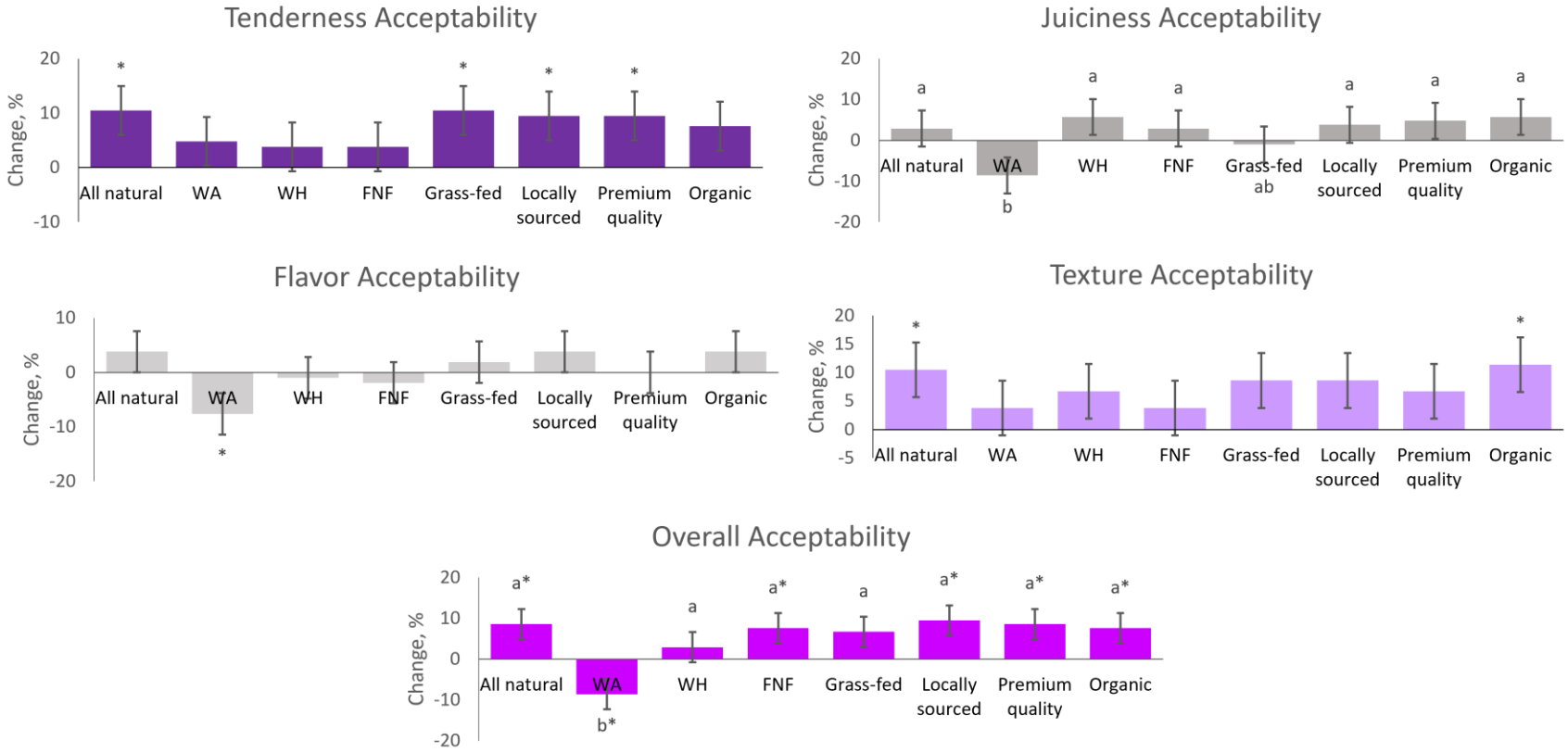


Figure 3-2. Change in the percentage of samples rated as acceptable by consumers due to labeling information disclosure prior to sample evaluation. [ab] Least square means within the same trait lacking a common superscript differ ($P < 0.05$). * Mean differs from 0 ($P < 0.05$).



Appendix A - Consumer Panel Evaluation Forms

INFORMED CONSENT STATEMENT

1. I volunteer to participate in research involving Sensory Evaluation of Meat. This research will be conducted by personnel in the Department of Animal Sciences and Industry at Kansas State University.

2. I fully understand the purpose of the research is for the evaluation of beef steaks, pork chops, lamb chops, goat meat, poultry meat, ground meat, and processed meat products from the previously mentioned species for the sensory traits of tenderness, juiciness, flavor intensity, connective tissue amount, off flavor presence, odor, and color and sensory evaluation will last approximately one hour.

3. I understand that there are minimal risks associated with participating and that those risks are related to possible food allergies. All meat products will be USDA inspected and all ingredients are GRAS (generally accepted as safe) by FDA.

4. I understand that my performance as an individual will be treated as research data and will in no way be associated with me for other than identification purposes, thereby assuring confidentiality of my performance and responses.

5. My participation in this study is purely voluntary; I understand that my refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled and that I may discontinue participation at any time without penalty or loss of benefits to which I am otherwise entitled.

6. If I have any questions concerning my rights as a research subject, injuries or emergencies resulting from my participation, I understand that I can contact the Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, at (785) 532-3224.

7. If I have questions about the rationale or method of the study, I understand that I may contact, Dr. Travis O'Quinn, 247 Weber Hall, Kansas State University, Manhattan, KS 66506, at (785) 532-3469 or Sally Stroda, 107 Weber Hall, at 785-532-1273.

I have read the Subject Orientation and Test Procedure statement and signed this informed consent statement, this _____ day of _____, _____.

_____ _____

Printed name Signature

Please sign and return one copy. The second copy is for your records.

Fat Big Panel 1 - Red

Start of Block: Demographics

Q10 Big Panel 1 - Red

Q1 Please tell us a little about yourself.

Q2 Panelist Number

_____

Q3 Gender

- Male (1)
- Female (2)

Q4 Age

- ○ Under 20 (1)
- ○ 20 to 29 years old (2)
- ○ 30 to 39 years old (4)
- ○ 40 to 49 years old (7)
- ○ 50 to 59 years old (8)
- ○ over 60 (9)

Q5 Ethnic Origin

- ○ African American (1)
- ○ Asian (2)
- ○ Caucasian/White (3)
- ○ Hispanic (4)
- ○ Native American (5)
- ○ Other (6)
- ○ Mixed Race (7)

Q6 Marital Status

- ○ Single (1)
- ○ Married (2)

Q7 Household Size

- ○ 1 person (1)
- ○ 2 People (2)
- ○ 3 People (3)
- ○ 4 People (4)
- ○ 5 People (5)
- ○ 6 People (6)
- ○ > 6 People (7)

Q8 Annual Household Income

- ○ < $25,000 (1)
- ○ $25,000 - $34,999 (2)
- ○ $35,000 - $49,999 (3)
- ○ $50,000 - $74,999 (4)
- ○ $75,000 - $99,999 (5)
- ○ $100,000 - $149,999 (6)
- ○ $150,000 - $199,999 (7)
- ○ > $199,999 (8)

Q9 Highest Level of Education Completed

- ○ Non-High School Graduate (1)
- ○ High School Graduate (2)
- ○ Some College / Technical School (3)
- ○ College Graduate (4)
- ○ Post-College Graduate (5)

Q12 When eating ground beef**,** what palatability trait is the most important to you?

- Flavor (1)
- Juiciness (2)
- Tenderness (3)
- Texture (4)

Q14 When eating ground beef, what degree of doneness do you prefer?

- Very Rare (1)
- Rare (2)
- Medium-Rare (3)
- Medium (4)
- Medium-Well (5)
- Well-Done (6)
- Very Well-Done (7)

Q234 What type of ground beef do you typically purchase at retail?

_____

Q16 How many times a week do you consume ground beef?

0 3 6 9 12 15 18 21

None ()	

End of Block: Demographics

Start of Block: Purchasing Motivators

Q88 Please indicate the importance of each trait when purchasing ground beef (hamburger).

Q200 Animal fed a grass-based diet.

	Extremely Unimportant	Extremely Important
	0	100
. ()		

Q203 Animal fed a grain-based diet.

	Extremely Unimportant	Extremely Important
	0	100
. ()		

Q201 Animal not administered antibiotics.

	Extremely Unimportant	Extremely Important
	0	100
. ()		

Q209 Animal Welfare

	Extremely Unimportant	Extremely Important
	0	100
. ()		

Q89 Appearance - Lean to Fat Ratio

	Extremely Unimportant	Extremely Important
	0	100

1 ()	

Q91 Brand of Product

Extremely Unimportant Extremely Important

0 100

1 ()	

Q90 Color

Extremely Unimportant Extremely Important

0 100

1 ()	

Q93 Fat Content

Extremely Unimportant Extremely Important

	0	100
1 ()		

Q202 Growth promotant use in the animal.

	Extrememly Unimportant	Extremely Important
	0	100
. ()		

Q204 Fresh Never Frozen

	Extremely Unimportant	Extremely Important
	0	100
. ()		

Q99 Locally Raised

	Extremely Unimportant	Extremely Important
	0	100
1 ()		

Q95 Natural or Organic Claims

	Extremely Unimportant	Extremely Important
	0	100
1 ()		

Q205 Nutrient Content

	Extremely Unimportant	Extremely Important
	0	100
. ()		

Q96 Packaging Type

	Extremely Unimportant	Extremely Important
	0	100
1 ()		

Q97 Preformed Patty

	Extremely Unimportant	Extremely Important
	0	100
1 ()		

Q98 Price

	Extremely Unimportant	Extremely Important
	0	100
1 ()		

Q198 Primal Source (i.e. Round, Chuck, etc.)

	Extremely Unimportant	Extremely Important
	0	100
. ()		

Q206 Size, weight, and thickness

	Extremely Unimportant	Extremely Important
	0	100
. ()		

End of Block: Purchasing Motivators

Start of Block: Sample 1

Q18 Sample Number

- ○ 5842 (1)

Q21 Juiciness

	Extremely Dry	Neither Juicy nor Dry	Extremely Juicy
	0	50	100
1 ()			

Q24 Was the sample acceptable for juiciness?

- Acceptable (1)
- Unacceptable (2)

Q25 Tenderness

	Extremely Tough	Neither Tender nor Tough	Extremely Tender
	0	50	100
1 ()			

Q27 Was the sample acceptable for tenderness?

- ○ Acceptable (1)
- ○ Unacceptable (2)

Q106 Flavor

	Dislike Extremely	Neither Like nor Dislike	Like Extremely
	0	50	100
6 ()			

Q107 Was the sample acceptable for flavor?

- ○ Acceptable (1)
- ○ Unacceptable (2)

Q207 Texture

	Dislike Extremely	Neither Like nor Dislike	Like Extremely
	0	50	100

. ()	

Q208 Was the sample acceptable for texture?

- ○ Acceptable (1)
- ○ Unacceptable (2)

Q28 Overall Liking

	Dislike Extremely	Neither Like nor Dislike	Like Extremely
	0	50	100
2 ()			

Q30 Was the sample acceptable overall?

- ○ Acceptable (1)
- ○ Unacceptable (2)

Q31 How likely would you be to purchase this product?

	Extremely Unlikely	Neither Likely nor Unlikely	Extremely Likely
	0	50	100
. ()			

End of Block: Sample 1

Appendix B - Appendix Tables

Table B-1. Percentage change in consumer (*N*=315, 105 / panel group) ratings[1] of palatability traits when information about fat content, price, or primal source is given on ground beef versus no information[2] given.

	%					
Treatment	Tenderness	Juiciness	Flavor Liking	Texture Liking	Overall Liking	Purchasing Intent
Fat Panel[3]						
90% Lean/10% Fat	20.1*	5.2	25.2*	17.8	22.2*	-1.9
80% Lean/20% Fat	21.2*	15.4	25.3*	17.6	27.5*	5.4
73% Lean/27% Fat	24.2*	24.6*	32.6*	22.1*	27.1*	3.8
Lean	15.3	18.0	23.2*	17.7	14.4	-3.0
Extra Lean	10.1	11.7	21.1	19.6*	18.8	-2.1
SE[4]	9.9	10.0	11.3	9.3	9.8	4.8
P - value	0.40	0.08	0.88	0.99	0.62	0.29
Price Panel[5]						
Ultra-High	23.9*	46.1*	44.6*	42.6*	53.2[a]*	56.9*
High	17.4*	44.4*	42.2*	35.3*	46.4[ab]*	59.8*
Medium	19.4*	47.6*	47.1*	39.6*	57.0[a]*	76.3*
Low	12.0	28.7	40.2*	28.6*	27.9[b]	45.8*
Ultra-Low	20.3*	46.3*	34.2*	32.5*	30.6[b]*	49.3*
SE[4]	8.4	17.2	13.2	11.7	14.0	22.1
P - value	0.43	0.12	0.80	0.64	< 0.01	0.38
Primal Panel[6]						
Ground Chuck	29.1[a]*	36.3*	49.3*	41.5*	47.4*	64.8*
Ground Round	14.6[b]*	29.0*	45.9*	36.1*	27.6*	59.7*
Ground Sirloin	25.3[ab]*	34.3*	69.0*	33.6*	45.5*	73.1*
Store Ground	17.3[b]*	29.5*	50.5*	25.1*	28.1*	54.7*
SE[4]	7.2	8.8	22.1	9.4	13.5	23.5
P - value	0.04	0.40	0.25	0.21	0.27	0.52

[ab] Least square means within the same panel type of the same column lacking a common superscript differ ($P < 0.05$)

[1] Percentage change in ratings: (consumer trait scores – consumer NONE scores) / consumer NONE scores

[2] NONE sample – no information was provided

[3] Additional information provided about the fat and/or lean content of the sample provided to the consumer prior to sample evaluation.

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

[5] Additional information given about the price of the sample provided to the consumer prior to sample evaluation. Prices: Ultra-High - $13.78/kg; High - $11.02/kg; Medium - $8.27/kg; Low - $5.51/kg; Ultra-Low - $2.75/kg.

[6] Additional information given about the primal source of the sample provided to consumers prior to sample evaluation.

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

Table B-2. Change in the percentage of ground beef patties rated acceptable[1] by consumers (*N* = 315, 105 / panel group) for tenderness, juiciness, flavor, texture, and overall liking when information is given about the fat content, price, or primal source versus no information given.

	%				
Treatment	Tenderness Acceptability	Juiciness Acceptability	Flavor Acceptability	Texture Acceptability	Overall Acceptability
Fat Panel[3]					
90% Lean/10% Fat	3.8[a]	-12.5[b]*	-1.9	6.0	-0.8
80% Lean/20% Fat	8.3[a]	1.7[a]	5.4	10.3*	8.4
73% Lean/27% Fat	3.8[a]	-1.0[a]	3.8	6.0	1.1
Lean	0.8[ab]	-5.9[ab]	-3.0	1.0	-1.0
Extra Lean	-9.2[b]	-11.9[b]*	-2.1	0.8	-7.0
SE[4]	5.4	4.4	4.8	4.3	5.2
P - value	0.04	0.02	0.29	0.41	0.10
Price[5] Panel					
Ultra-High	7.6	11.3[a]*	15.2[ab]*	2.9	12.4*
High	5.6	10.5[a]	6.4[bc]	3.5	11.1*
Medium	7.6	12.4[a]*	16.0[a]*	7.6	13.3*
Low	1.7	2.9[b]	3.7[c]	2.7	3.7
Ultra-Low	8.6	10.5[a]	4.8[c]	4.8	7.6
SE[4]	4.5	5.3	5.4	4.8	5.1
P - value	0.22	0.03	0.02	0.78	0.14
Primal Panel[6]					
Ground Chuck	0.7	5.8*	7.7	7.5	3.3
Ground Round	2.0	5.0	7.2	5.0	4.8
Ground Sirloin	3.5	6.7*	9.8	2.7	5.6
Store Ground	0.4	3.9	2.8	2.5	4.2
SE[4]	3.7	2.8	5.5	4.0	4.3
P - value	0.87	0.83	0.49	0.60	0.96

[abc] Least squares means within the same panel type of the same column lacking a common superscript differ ($P < 0.05$)

[1] Percentage change in acceptability: (consumer trait acceptability – consumer NONE acceptability) / consumer NONE acceptability; Acceptable = 100, Unacceptable = 0

[2] NONE sample – no information was provided.

[3] Additional information provided about the fat and/or lean content of the sample provided to the consumer prior to sample evaluation.

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

[5] Additional information given about the price of the sample provided to the consumer prior to sample evaluation. Prices: Ultra-High - $13.78/kg; High - $11.02/kg; Medium - $8.27/kg; Low - $5.51/kg; Ultra-Low - $2.75/kg.

[6] Additional information given about the primal source of the sample provided to consumers prior to sample evaluation.

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

Table B-3. Percentage change in consumer (*N* = 105) ratings[1] of palatability traits when labeling information is given on ground beef patties versus no information[2] given.

	%					
Term[3]	Tenderness	Juiciness	Flavor Liking	Texture Liking	Overall Liking	Purchasing Intent
All Natural	25.0*	18.4	23.8^{ab}*	30.6*	30.1*	34.1*
Animal raised without added antibiotics.	16.6	6.9	10.4^{cd}	26.5	28.6*	25.5*
Animal raised without added hormones.	17.9	24.5*	12.5^{bcd}	44.0*	29.8*	28.1*
Fresh never frozen	12.7	18.3	15.9^{abcd}	22.4	39.0*	32.0*
Grass-fed	23.4*	23.0*	26.5^{a}*	36.1*	25.2	39.8*
Locally sourced	20.7*	20.7*	22.4^{abc}*	33.8*	34.9*	36.8*
Premium quality	15.3	20.9*	8.6^{d}	21.7	28.9*	17.4
USDA Organic	18.1	24.0*	22.1^{abc}*	28.4	30.0*	48.6*
SE[4]	10.0	9.4	8.0	14.9	13.8	11.4
P - value	0.76	0.36	0.03	0.49	0.97	0.12

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

[1] Percentage change in ratings: (consumer trait scores – consumer NONE scores) / consumer NONE scores.

[2] NONE sample – no information was provided.

[3] Labeling terms and information provided to consumers prior to sample evaluation.

[4] SE (largest) of the least square means.

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

Table B-4. Change in the percentage of ground beef patties rated acceptable[1] by consumers (*N* = 105) for tenderness, juiciness, flavor, texture, and overall liking when labeling information is given versus no information[2] given.

	%				
Term[3]	Tenderness Acceptability	Juiciness Acceptability	Flavor Acceptability	Texture Acceptability	Overall Acceptability
All Natural	10.5*	2.9[a]	3.8	10.5*	8.6[a]*
Animal raised without added antibiotics.	4.8	-8.6[b]	-7.6*	3.8	-8.6[b]*
Animal raised without added hormones.	3.8	5.7[a]	-1.0	6.7	2.9[a]
Fresh never frozen	3.8	2.9[a]	-1.9	3.8	7.6[a]*
Grass-fed	10.5*	-1.0[ab]	1.9	8.6	6.7[a]
Locally sourced	9.5*	3.8[a]	3.8	8.6	9.5[a]*
Premium quality	9.5*	4.8[a]	0.0	6.7	8.6[a]*
USDA Organic	7.6	5.7[a]	3.8	11.4*	7.6[a]*
SE[4]	4.5	4.4	3.8	4.8	3.7
P - value	0.27	0.02	0.08	0.20	< 0.01

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

[1] Percentage change in acceptability: (consumer trait acceptability – consumer NONE acceptability) / consumer NONE acceptability; Acceptable = 100, Unacceptable = 0

[2] NONE sample – no information was provided.

[3] Labeling terms and information provided to consumers prior to sample evaluation.

[4] SE (largest) of the least square means.

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