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Influence of Production Practice Information on Consumer Eating Quality Ratings of Beef Top Loin Steaks

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Abstract: The purpose of this study was to identify if consumers' palatability scores of beef top loin steaks were affected by disclosing production practices or brands related to each product. Strip loins were selected to represent 5 treatments: Grain-Fed Natural (Natural), Certified Angus Beef (CAB), Local Grass Fed (Grass), USDA Select (Conventional), and USDA Certified Organic (Organic). Two separate experiments were conducted (n = 120/experiment). In Experiment 1 and 2, panelists received the 5 treatment samples in a standard blind testing format in segment 1 (S1). In the second segment (S2) of Experiment 1, short descriptions were read aloud to participants before receiving each of their 5 samples, but all samples were actually USDA Select (false disclosure). In the second segment of Experiment 2, treatment descriptions were provided that matched the 5 treatments samples (true disclosure). When consumers evaluated samples in S1, they rated the Natural and CAB samples more tender and juicier ($P < 0.05$) than the other 3 treatments, and Organic was the least tender. Flavor and overall liking were greater ($P < 0.05$) for Natural and CAB steaks, while Conventional was intermediate, and flavor and overall liking were lowest for Grass and Organic ($P < 0.05$). When consumers received Select samples representing the 5 treatments, false disclosure decreased tenderness and juiciness of Natural, increased flavor liking of CAB, and increased tenderness, flavor liking, and overall liking of Organic ($P < 0.05$). True treatment disclosure increased flavor liking and overall liking of CAB and Grass, increased overall liking of Natural, and decreased juiciness of Conventional ($P < 0.05$). These results indicate consumers' perception of eating quality can be influenced by quality differentiated brand names and labeling claims, particularly claims related to production practices.

Keywords: brand recognition, consumer, conventional beef, grass-fed, natural beef, organic
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Introduction

U.S. consumers tend to focus on product attributes, such as color, leanness, marbling, USDA quality grades, and past palatability experiences to determine beef quality at the point of purchase (Claborn et al., 2011; Umberger et al., 2009a; Wilfong et al., 2016). However, consumers now include credence attributes, such as "natural", "organic", free-range", and "local" in their search criteria (Umberger et al., 2009a). Consumer interest in grass- or forage-finished/fed beef has also grown (Martin, 2004; Lin, 2013) over health concerns and worries about the effects conventional beef production may have on food safety and the environment (Umberger et al., 2009a).

According to National Meat Case Study results, production claims for Natural and Organic continue to climb, reaching nearly 40 and 4%, respectively, of packages available nationwide (Kelly, 2016). Despite the popularity of organic ground beef (5.35%) in comparison to other species, organic beef (whole muscle) is not as widely popular (2.25%), but Natural beef (10.55%) and Natural ground beef (32.4%) were more common in 2015 National Meat Case Study and have steadily had increased meat case presence since the audits first took place (Kelly, 2016; Johnston et al., 2017).

Several studies have indicated that consumers are willing to pay premiums for branded beef products and beef with credence attributes they desire (Abidoye et al., 2011; Acevedo et al., 2006; Grannis and Thilmany, 2000; Umberger et al., 2009b); however, brand names do not always affect consumers' purchasing patterns for natural or regular beef (Goss et al., 2002). Increased marbling, which serves as the cornerstone of numerous certified beef programs (USDA, 2018), typically improves consumer eating quality (Corbin et al., 2015; Hunt et al., 2014; O'Quinn et al., 2012). However, few studies have evaluated the palatability-related value of product awareness through quality-driven branding or provision of information on production practices. Therefore, the purpose of this study was to identify if consumers' palatability scores of beef top loin steaks were affected by disclosing production practices or brands related to each product.

Materials and Methods

Experimental treatments and sample preparation

Beef strip loins (Institutional Meat Purchase Specification #180; NAMP, 2011), representing 5 different treatments were selected or purchased for this study. Treatments included Conventionally raised beef that were graded as USDA Select (Conventional), Certified Angus Beef (CAB), Local Grass-Fed (Grass), Grain-Fed Natural (Natural), and USDA Certified Organic (Organic). Trained personnel at Texas Tech University were used to select and collect 28 sides of beef (20 USDA Select, 8 USDA upper 1/3 Choice, qualifying for CAB) from a commercial abattoir in Omaha, Nebraska. Grass-fed strip loins (n = 10) were collected from a local abattoir in Wolfforth, Texas from ten sides of beef representing cattle fed grass their entire lives. Natural (n = 8) and Organic (n = 10) strip loins were procured from local supermarkets in Lubbock, TX based on labeling claims and certification. Strip loins were collected from each carcass and transported or shipped to the Gordon W. Davis Meat Science Laboratory, Lubbock, Texas and aged at 2 to 4°C until 21 d postmortem under vacuum, with the exception that Grass was aged until 24 d postmortem (due to logistical issues getting the Grass strip loins frozen at the specified aging period of the other treatments).

Subprimals were fabricated into 2.54-cm thick steaks from the anterior to posterior end of the strip loin and vacuum packaged individually. The most anterior steak from each strip loin was retained for compositional analysis and the second steak was designated to Warner-Bratzler shear force analysis. All remaining steaks were then individually vacuum packaged with a label according to their anatomical position for consumer testing. At 21 d postmortem (or 24 d postmortem for Grass), steaks were frozen and stored at –20°C in the absence of light until being used for their respective analysis.

Color, compositional, and pH analyses

Following strip loin fabrication, the steak reserved for proximate analysis was placed on a table with the cut surface exposed and allowed to oxygenate for twenty minutes in the same room were fabrication occurred, which is maintained at 2 to 4°C. After twenty minutes, L*, a*, and b* were measured using a handheld spectrophotometer (Model 45/0-L Hunter MiniScan XE Plus, Hunter Associates Laboratory, Reston, VA) with illuminant A, a standard observer angle of 10° and a 2.54-cm aperture (CIE, 1976). Instrument calibration was completed before use at each sampling period, and after every 10th observation using black and white tiles (American Meat Science Association, 2012). Three readings were taken across the cut surface of the steak and analyzed as an average of the three readings. Following instrumental color assessment, steaks were individually vacuum packaged and frozen at –10°C until compositional analysis

Compositional analysis was used to determine the chemical percentage of fat, protein, and moisture. Steaks were thawed at 2 to 4°C for 24 h prior to compositional and pH analysis. External connective tissue and fat were removed from each steak. Each sample was coarse ground through a table-top grinder (Krups 150-Watt Meat Grinder item #402–70, Krups, Shelton, CT) to obtain a 200-g sample. Proximate analysis was conducted using an AOAC-approved (Official Method 2007. 04; Anderson, 2007) near infrared spectrophotometer (FoodScan, FOSS NIRsystems, Inc., Laurel, MD). Fifteen independent readings were taken per sample and averaged for the final reported chemical values of fat, protein, and moisture.

Individual samples (10-g) were mixed with 90 mL of distilled water for 1 min in a tabletop blender (Model 80335R, Hamilton Beach Brands, Glen Allen, VA) to allow for homogenization. Homogenized samples were placed in a 150 mL beaker with a filter cone. Sample pH was measured with a bench top probe-type pH meter (Model 14703; Denver Instrument Company, Bohemia, NY). Samples for pH analyses were measured in triplicate and averaged prior to statistical analysis.

Warner-Bratzler shear force analysis

For shear force analysis, steaks were thawed overnight at 2 to 4°C and cooked to an internal temperature of 71°C monitored using a thermocouple probe (Type J, Cole Parmer, Vernon Hills, IL) attached to a thermometer (Digi-Sense; Cole Parmer). Steaks were cooked on a belt grill (model TBG- 60 Magigrill, Magi-Kitch'n Inc., Quakertown, PA). Steaks were cooled overnight at 2 to 4°C. Six 1.3-cm cores were removed parallel to the muscle fiber from each steak and sheared once perpendicular to the muscle fiber using a WBSF analyzer (G-R Elec. Mfg., Manhattan, KS). The values from the 6 cores from each steak were recorded (kg) and averaged.

Consumer sensory evaluations

Steaks for consumer testing were thawed overnight prior to their predetermined cooking day and cooked as described above. Consumer panels were conducted at the Texas Tech University Animal and Food Science building where panelists were recruited from Lubbock, TX and surrounding areas. Panelists had to be at least 18 yr of age, were paid to participate, and were only allowed to participate once. Twelve panels of twenty consumers were conducted and lasted approximately 1 h and 20 min. Two panels were conducted per night for 6 nights.

The panels took place in a large room under fluorescent lighting, and the tables were divided into individual sensory booths. Each consumer was provided a numbered consumer booth, plastic utensils, toothpick, napkin, expectorant cup, cup of water, cup of apple juice, and crackers to use as palate cleansers between samples. Before the start of each panel, panelists were given verbal instructions about the ballot and use of palate cleansers. Prior to tasting any samples, consumers filled out a demographic questionnaire and completed a survey pertaining to their knowledge of beef production systems. Consumers were given a list of phrases and were asked to circle all that they felt pertained to each production system (CAB, Grass, Natural, Conventional, and Organic).

Two separate experiments were conducted, with 120 participants per experiment. All consumers received 10 samples in a series of two segments both containing 5 samples. A break period lasting approximately 10 min was observed between the 2 segments. In the first segment (S1) of Experiment 1, panelists received the 5 treatment samples in a standard blind format without knowledge of the treatments. In the second segment (S2) of Experiment 1, short descriptions were read aloud to participants before receiving each of their 5 samples for evaluation:

> Certified Angus Beef: "The sample that you are receiving is a premium Certified Angus Beef Choice product. These cattle are conventionally raised and are from one of the highest quality grades of beef. Certified Angus Beef represents only the top 8% of USDA quality graded cattle in the United States."
>
> Conventional: "The sample you are receiving is from conventionally raised beef that were produced at a commercial feedyard and fed a corn-based diet for the last 120+ days. Additionally, the cattle were administered growth promotants including β-agonists, implanted with steroidal implants, and fed sup-therapeutic levels of antibiotics."
>
> Natural: "The sample you are receiving is a natural product that contains no artificial ingredients, added colors, or preservatives. The cattle were finished on a corn-based diet and never administered antibiotics, growth promotants or animal byproducts."
>
> Local Grass-Fed: "The sample you are receiving is from cattle that were fed only a grass-based diet for the entirety of their lives, and raised locally in the Panhandle of Texas."
>
> Organic: "The sample you are receiving is USDA Certified Organic. The sample is from animals that were never administered hormones, growth promotants, additives, animal by-products, antibiotics, synthetic parasiticides and were raised exclusively on pasture with access to sunlight, fresh air, exercise and shelter."

Participants were, however, served a sample representing top loin from beef graded as USDA Select, as opposed to beef matching the description being read. This will be referred to as false informed testing or false disclosure. These samples will be referred to as False-CAB, False-Grass, False-Natural, False-Organic, False-Conventional. For each consumer their blind Conventional steak from S1 and all 5 Select steaks fed in S2 were derived from the same strip loin.

In Experiment 2, the blind testing segment was identical to Experiment 1. Again, in the second segment, treatment descriptions were read aloud to the participants; however, the 5 treatment samples corresponded to the

Table 1. The effects of treatment on instrumental color, proximate composition and pH of raw beef top loin steaks and Warner-Bratzler shear force (WBSF) of cooked top loin steaks.

Treatment[1]	L^*	a^*	b^*	Fat, %	Moisture, %	Protein, %	pH	WBSF, kg
CAB	42.4[a]	29.8[a]	25.2[ba]	8.05[a]	68.1[d]	24.0[b]	5.60[b]	2.35[c]
Grass	31.6[d]	30.8[a]	26.4[a]	3.86[b]	72.3[b]	23.6[b]	5.60[b]	2.74[bc]
Natural	39.4[ba]	25.3[b]	23.5[b]	7.34[a]	69.0[d]	23.4[b]	5.71[a]	2.45[bc]
Organic	34.5[c]	28.5[a]	24.9[b]	1.99[c]	75.2[a]	21.4[c]	5.77[a]	3.95[a]
Conventional	38.1[b]	29.5[a]	24.7[b]	4.23[b]	70.8[c]	25.1[a]	5.51[c]	2.80[b]
SEM[2]	1.10	1.01	0.73	0.39	0.44	0.34	0.031	0.16
P value	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

[1]Treatments: CAB = Certified Angus Beef; Grass = Local Grass Fed; Natural = Grain Fed Natural, Conventional = USDA Select.

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

actual treatment descriptions being read. This will be referred to as informed tasting or true disclosure. These samples will be referred to as Informed-CAB, Informed-Grass, Informed-Natural, Informed-Organic, and Informed-Conventional. For each consumer, steaks from Segment 1 were paired with a steak removed from an adjacent position within their respective strip loin and served during informed tasting during segment 2 to help alleviate any positional effect that may impact palatability responses.

Consumers evaluated each sample for tenderness, juiciness, flavor liking, and overall liking on 100-mm continuous line scales for each palatability trait. On the scale, 0 mm was verbally anchored as not tender, not juicy, and dislike extremely, and 100 mm was verbally anchored at very tender, very juicy, and like extremely. The consumer was also asked to indicate if the sample was acceptable or not acceptable for each trait. Furthermore, consumers were asked to designate each sample as “Unsatisfactory”, “Good everyday quality”, “Better than everyday quality”, or “Premium quality”. Consumers indicated retail willingness to pay (WTP).

Statistical analysis

Statistical analyses were conducted using PROC GLIMMIX of SAS (Version 9.4; SAS Inst. Inc., Cary, NC). The model for objective measures (composition, pH, instrumental color, and shear force) included the fixed effect of treatment. For all consumer panel data, the model included the fixed effect of treatment and the random effect of panel session number. Acceptability data for consumer sensory ratings were analyzed with a model that included a binomial error distribution. Treatment least squares means were separated with the PDIFF option of SAS using a significance level of $P \leq 0.05$. Denominator degrees of freedom were calculated using the Kenward-Roger approximation. Consumer demographic information was summarized using PROC FREQ. Pearson correlations coefficients were generated using PROC CORR to determine relationships between objective measures of quality and consumer responses ($P < 0.05$).

Results and Discussion

Instrumental color of raw steaks

Treatment had an impact on all three components of instrumental color ($P < 0.01$; Table 1). Natural and CAB steaks had the lightest color ($P < 0.05$) as evidenced by higher L^* values compared to all other treatments, with the exception that Natural was also similar to Conventional ($P > 0.05$). Meanwhile, Grass steaks were darker ($P < 0.05$) than all other treatments. Natural had the lowest a^* value and was less red ($P < 0.05$) than all other treatments. Grass steaks had greater b^* values ($P < 0.05$) than Natural, Organic, and Conventional, indicating those steaks were more yellow, but did not differ ($P > 0.05$) from CAB.

Previous researchers have shown L^* values increase (or tend to increase) as quality grade increases (Claborn et al., 2011; Garmyn et al., 2014), which aligns with the current results as CAB and Natural had the greatest intramuscular fat percentage along with the greatest L^* values. Moreover, Garmyn et al. (2010) showed that top loin steaks from concentrate-fed heifers had greater L^* values than steaks from forage-fed heifers, which could be partially due to the lower marbling score of the forage-fed beef. However, finishing diet did not influence a^* or b^* values according to Garmyn et al. (2010), which both supports the results for a^* values, but contradicts the findings for b^* values in the current study.

Composition, pH, and Warner-Bratzler shear force

As seen in Table 1, treatment influenced ($P < 0.01$) proximate composition. The CAB and Natural had greater fat percentage ($P < 0.05$) than all other treatments, Grass and Conventional were similar and intermediate ($P < 0.05$), and Organic had the lowest fat percentage ($P < 0.05$). Conventional and CAB had fat percentages within the range of previously reported values by authors specifically comparing top loin from Select and top (upper 2/3) Choice, where Select has ranged from 3.0– 4.7% fat and top Choice has ranged from 6.9–9.2% fat (Bueso et al., 2018, Gomez et al., 2018; Hunt et al., 2014). Given these ranges in fat percentages, the Natural treatment would also fall within this range for top Choice qualification, while Grass had a fat percentage consistent with previously reported values for Select, and Organic aligned with previously reported fat percentages of USDA Standard (Corbin et al., 2015; O'Quinn et al., 2012). Due to the inverse relationship between fat and moisture, Organic had greater ($P < 0.05$) moisture percentage than any other treatment, followed by Grass. Natural and CAB had less moisture than all other treatments ($P < 0.05$). Conventional had greater protein than all other treatments, while Organic had the lowest protein percentage ($P < 0.05$); all other treatments were intermediate and did not differ ($P > 0.05$). Natural and Organic had pH values greater ($P < 0.05$) than CAB, Grass, and Conventional. However, all pH values were below 5.8, which should have minimal biological significance, yet could impact meat quality.

Finally, treatment affected ($P < 0.01$) WBSF values (Table 1). Based on shear force, Organic samples were tougher ($P < 0.05$) than all other treatments. Steaks from CAB strip loins required less force to shear than Organic and Conventional but were similar ($P > 0.05$) to Grass and Natural. In support of the current findings, numerous authors have shown top (upper 2/3) Choice top loin steaks have lower shear force values than Select (Bueso et al., 2018; Claborn et al., 2011; Garmyn et al., 2011; Hunt et al., 2014; Lorenzen et al., 2003; Nelson et al., 2004).

Demographic profile of consumers

Demographic characteristics for consumers are shown in Table 2. There appeared to be a slightly greater proportion of female to male participants, along with a greater proportion of married versus single participants. Household size was evenly distributed between one and five people. Likewise, the age of participants and annual household incomes were uniformly dispersed between the six categories. Nearly thirty percent of participants had Hispanic ethnicity, while the majority were Caucasian/White. Finally, nearly 73% of participants had at least some college or were college graduates while very few had not yet graduated from high school.

Table 2. Demographic characteristics of consumers (n = 240) who participated in consumer sensory panels.

Item	Percentage of respondents
Gender	
Male	40.87
Female	59.13
Household Size	
1 person	15.32
2 people	22.98
3 people	18.30
4 people	22.55
5 people	15.74
6 people	2.98
> 6 people	2.13
Marital Status	
Single	40.34
Married	59.66
Age	
Under 20	9.24
20-29	18.91
30-39	24.79
40-49	19.75
50-59	14.71
> 60	12.18
Ethnic Origin	
African-American	5.73
Asian	0.88
Caucasian/White	59.47
Hispanic	29.96
Native American	0.44
Other	3.52
Annual Household Income	
Under $25,000	15.19
$25,000-$34,999	11.39
$35,000-49,999	13.50
$50,000-$74,999	27.85
$75,000-$100,000	10.55
>$100,000	21.52
Education Level	
Non-high school graduate	6.64
High school graduate	17.70
Some College/Technical School	43.81
College graduate	23.45
Post graduate	8.41

Purchasing habits of consumers

Prior to the start of the tasting sessions, consumers were asked to identify purchasing motivators; these re-

Table 3. Purchasing motivators of consumers (n = 240) who participated in consumer sensory panels.

Item	Percentage of respondents
Times a week beef is consumed	
None	0
1 to 3	43.70
4 to 6	46.64
> 7	9.66
Most important palatability trait	
Flavor	44.87
Juiciness	10.68
Tenderness	44.44
Meat product where flavor is most preferred	
Beef	71.24
Chicken	14.16
Fish	4.29
Lamb	0.86
Mutton	0
Pork	4.72
Shellfish	0.86
Turkey	1.29
Veal	0
Venison	2.58
Retail location most frequented	
Amigos	7.96
Lowes	0.44
Market Street	41.15
Natural Grocers	0.44
Sprouts	0.44
United	32.30
Wal-Mart	16.81
Whole Foods	0.44
Beef product most frequently purchased	
Certified Angus Beef	34.60
Grass-Fed	2.53
Lowest Priced	12.66
Natural	6.75
No-Preference	33.76
Organic	1.69
Store Brand	8.02

sults can be found Table 3. An overwhelming proportion of consumers eat beef 1 to 6 times per week, while nearly ten percent eat beef at least daily. When consumers were asked which palatability trait was most important while eating beef, flavor and tenderness were easily identified as driving factors receiving support from nearly ninety percent of consumers, which is similar to previous results (Corbin et al., 2015; Hunt et al., 2014; Lucherk et al., 2016). However, tenderness and flavor were equally selected as most important in the current study, but flavor was the predominant choice for Corbin et al. (2015) and tenderness was more common in the results of Hunt et al. (2014). Next, consumers were asked to identify which meat product they preferred for flavor from a list of several red meat and poultry species; over 70% of consumers stated that beef flavor was the most preferred. Similarly, Lucherk et al. (2016) found that 70.7% of consumers preferred beef flavor over other meat flavors. Consumers most frequently shopped at local Texas chain grocery stores, such as United or Market Street retail locations when purchasing meat products in Lubbock, Texas. Approximately one-third of consumers indicated they most frequently purchase Certified Angus Beef when buying beef, while another third had no preference when shopping for beef to purchase.

Production system questions

Consumers were presented with a list of potential descriptors for five production systems (branded product, labeling claims, and/or production system) and were asked to select any or all phrases they believe applied to each production system (Table 4). Those production systems included Certified Angus Beef, Conventional Beef, Grass-fed Beef, Natural Beef, and Organic Beef. A greater proportion of consumers associated Conventional with the following attributes more often than any of the other systems ($P < 0.01$): “Administered antibiotics”, “Administered growth promotants”, “Administered hormones”, “Least expensive type of beef”, “Fed animal by-products”, “Least healthy type of beef”, “Least nutritious type of beef”, “Worst production system for animal welfare”, and “Raised in confinement”. Consumers rarely associated Conventional beef with being the “Most expensive” or the “Most nutritious type of beef” in comparison to other production systems ($P < 0.01$). Consumers more often associated Certified Angus Beef with being the “Best tasting type of beef” and “Highest quality beef” by an overwhelming margin in comparison to other production systems ($P < 0.01$). As a consequence, they more often associated Certified Angus Beef, along with Organic, as being the “Most expensive type of beef”, more so than Grass, Natural, or Conventional. A greater proportion of consumers associated the Organic production system with the following attributes more than any of the other systems ($P < 0.01$): “Healthiest type of beef”, “Most nutritious type of beef”, “Best production system for animal welfare”, “Best production system for the environment”, and the “Safest type of beef”. In support of our consumers’ views, Van Loo et al. (2012) found that consumers perceive organic foods as safer and healthier than conventionally grown foods. As expected, a greater proportion of consumers associated “Grass finished” and “Raised on pasture” with Grass more than any other production system ($P <$

Table 4. Percentage of consumers indicating they associate the following phrases with the various beef production systems in question.

Phrase	Certified angus beef	Conventional beef	Grass-fed beef	Natural beef	Organic beef	SEM	*P*-value
Administered Antibiotics	18.3[b]	44.4[a]	11.7[bc]	13.3[bc]	8.3[c]	3.74	<0.01
Administered Growth Promotants	13.9[b]	37.8[a]	7.2[b]	10.6[b]	8.9[b]	3.22	<0.01
Administered Hormones	16.1[b]	39.4[a]	7.8[c]	6.7[c]	5.0[c]	3.30	<0.01
Best Tasting Type of Beef	53.3[a]	17.8[c]	18.9[c]	32.8[b]	20.6[c]	3.64	<0.01
Corn Finished	18.3[a]	19.4[a]	7.2[b]	20.0[a]	18.3[a]	2.85	<0.05
Family Run and Operated	15.6[c]	14.4[c]	35.6[ab]	40.0[a]	31.1[b]	4.03	<0.01
Least Expensive Type of Beef	3.9[c]	48.9[a]	10.6[b]	6.7[bc]	3.3[c]	2.49	<0.01
Most Expensive Type of Beef	55.6[a]	5.0[c]	15.0[b]	16.1[b]	54.4[a]	3.42	<0.01
Fed Animal-Byproducts	6.7[b]	23.3[a]	4.4[b]	6.1[b]	3.9[b]	2.09	<0.01
Grass Finished	12.8[c]	10.6[c]	58.6[a]	35.0[b]	29.4[b]	3.50	<0.01
Healthiest Type of Beef	19.4[b]	9.4[c]	21.7[b]	25.6[b]	45.0[a]	3.29	<0.01
Highest Quality Beef	55.0[a]	15.0[c]	13.3[c]	30.0[b]	26.7[b]	3.47	<0.01
Least Healthy Type of Beef	4.4[b]	22.8[a]	3.3[b]	3.3[b]	2.8[b]	2.05	<0.01
Leanest Type of Beef	22.8[ab]	16.1[b]	22.8[ab]	17.2[b]	27.2[a]	3.49	<0.05
Least Nutritious Type of Beef	1.7[b]	23.3[a]	3.9[b]	2.8[b]	2.2[b]	1.83	<0.01
Most Nutritious Type of Beef	22.2[b]	10.6[c]	20.0[b]	20.0[b]	32.8[a]	3.58	<0.01
Best Production System for Animal Welfare	6.1[c]	6.1[c]	16.7[b]	16.1[b]	25.0[a]	2.53	<0.01
Best Production System for the Environment	7.2[c]	4.4[c]	19.4[b]	16.7[b]	26.7[a]	2.65	<0.01
Worst Production System for Animal Welfare	5.6[b]	22.2[a]	2.8[b]	2.8[b]	3.9[b]	2.12	<0.01
Raised in Confinement	15.0[b]	34.4[a]	5.6[c]	6.1[c]	11.1[bc]	2.90	<0.01
Raised Locally	18.3[bc]	11.1[c]	23.9[ab]	30.6[a]	17.8[bc]	4.04	<0.01
Raised on Pasture	16.1[d]	15.6[d]	63.3[a]	47.2[b]	36.7[c]	3.31	<0.01
Safest Type of Beef	18.9[bc]	11.7[c]	17.2[bc]	20.6[b]	36.1[a]	3.42	<0.01
Most Sustainable	13.9	16.7	11.1	14.4	15.6	3.61	0.61

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

0.01). "Family run and operated" and "Raised locally" were more often associated with Natural and Grass ($P < 0.01$) than other production systems. According to Goss et al. (2002), consumers mostly associate Natural beef with hormone- and antibiotic-free production systems, as opposed to family farms or environmental awareness, but Onozaka et al. (2010) found that consumers associate the words 'Local' and 'Natural' with feelings of healthfulness, quality, and good food safety. Aside from Grass, "Corn-finished" was equally associated with CAB, Conventional, Natural and Organic ($P < 0.01$). Interestingly, consumers do not necessarily associate Organic with being "Raised on pasture", especially when compared to Natural or Grass ($P < 0.01$).

Palatability Ratings

In the first segment, when consumers received each of the 5 treatment samples without knowledge of the sample treatments, consumers rated Natural and CAB more tender ($P < 0.05$) than Grass, Conventional, and Organic (Table 5). In this instance, Natural and CAB would both qualify for Top Choice programs based on their fat percentage, and previous studies support our findings that greater consumer tenderness scores result from strip loins with higher quality grades and fat percentages compared to lower quality grades (Corbin et al., 2015; Hunt et al., 2014; O'Quinn et al., 2012). Additionally, Organic was rated less tender than any other treatment ($P < 0.05$). Much like the results for tenderness, consumers rated Natural and CAB juicier ($P < 0.05$) than Grass, Organic, and Conventional, which did not differ ($P > 0.05$). Consumers liked the flavor of Natural and CAB steaks more than the other treatments ($P < 0.05$), while Conventional was intermediate, and flavor liking of Grass and Organic was lowest ($P < 0.05$). A similar trend was observed for overall liking ($P < 0.05$).

When Sitz et al. (2005) matched U.S. strip steaks to Australian grass-fed strip steaks according to similar Warner-Bratzler shear force values and marbling, US consumers were accustomed to US domestic beef flavor and preferred that over grass-fed beef. This trend can also be observed in the current findings. Conventional and Grass had similar fat percentages, yet consumers preferred the flavor of grain-fed beef. Grass-fed beef flavor certainly varies from country to country depend-

Table 5. Consumer (n = 120) palatability ratings, acceptability percentages, and willingness to pay for blind and false informed testing of top loin samples in Experiment 1.

Treatment[1]	Tenderness[2]	Juiciness[2]	Flavor liking[2]	Overall liking[2]	Tenderness, %	Juiciness, %	Flavor liking, %	Overall liking, %	$/lb.
Blind Testing									
CAB	64.6^{ab}	66.3^{a}	58.6^{bcd}	59.7^{bc}	85.9^{ab}	85.9^{ab}	82.8^{abcd}	85.3^{a}	8.67^{cde}
Grass	54.6^{cd}	58.2^{bc}	42.4^{e}	47.1^{d}	77.6^{bc}	77.6^{bc}	54.2^{e}	59.3^{b}	6.54^{fg}
Natural	68.4^{a}	66.2^{a}	63.4^{ab}	64.8^{ab}	90.9^{a}	90.9^{a}	86.1^{abc}	88.5^{a}	10.17^{abc}
Organic	42.7^{e}	56.6^{bc}	43.2^{e}	43.9^{d}	75.7^{cd}	76.3^{bc}	58.9^{e}	60.6^{b}	5.93^{g}
Conventional	52.7^{d}	54.1^{bc}	52.6^{d}	55.0^{c}	71.4^{cd}	71.4^{cd}	72.4^{d}	79.5^{a}	7.42^{efg}
False Informed Testing									
False-CAB	63.3^{ab}	59.7^{ab}	66.9^{a}	66.3^{a}	74.8^{cd}	74.2^{cd}	91.0^{a}	88.6^{a}	11.04^{a}
False-Grass	55.0^{cd}	53.1^{bc}	58.4^{bcd}	61.1^{abc}	70.1^{cd}	70.1^{cd}	81.1^{bcd}	81.8^{a}	8.75^{cde}
False-Natural	55.1^{cd}	54.1^{bc}	60.1^{bc}	60.6^{abc}	70.9^{cd}	70.9^{cd}	83.6^{abc}	83.7^{a}	9.04^{bcd}
False-Organic	60.4^{bc}	56.3^{bc}	62.6^{ab}	63.1^{ab}	77.4^{cd}	77.4^{bc}	88.5^{ab}	86.8^{a}	10.33^{ab}
False-Conventional	52.5^{d}	50.7^{c}	55.0^{cd}	55.4^{c}	64.2^{d}	64.2^{d}	77.0^{cd}	79.5^{a}	7.58^{def}
P–value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
SEM	3.11	3.08	2.74	2.98	4.52	4.52	5.25	5.23	0.68

[a-f]Within a column, least squares means without a common superscript differ ($P < 0.05$).

[1]Treatments: CAB = Certified Angus Beef; Grass = Local Grass Fed; Natural = Grain Fed Natural, Conventional = USDA Select.

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

ing on the type, quality, and maturity of the forage the cattle consume, but Corbin et al. (2015) also found that consumers rated grass-finished samples (with fat percentage equivalent to Select) lowest for flavor liking and overall liking when compared to grain-fed beef ranging from USDA Standard up to USDA Prime.

In the second segment of Experiment 1 when consumers received Select samples representing the 5 treatments, they rated False-CAB more tender ($P < 0.05$) than False-Grass, False-Natural, and False-Conventional, but False-CAB did not differ from False-Organic ($P > 0.05$). This contradicts consumer tenderness ratings from segment 1 when samples were served in a blind tasting format. Gallina et al. (2012) reported a similar phenomenon testing organic and conventional yogurt. Consumers were unable to differentiate between conventional and organic yogurt initially, but when they were given a conventional sample and were told it was organic, scores for palatability traits were greater (Gallina et al., 2012). Consumers rated False-CAB juicier than False-Conventional ($P < 0.05$), and the remaining samples did not differ ($P > 0.05$). Consumers scored False-Organic and False-CAB greater in flavor-liking than False-Conventional ($P < 0.05$); however, when consumers tasted the Organic samples during the blind testing format in segment one they preferred the flavor the least. Consumers liked False-Conventional less overall ($P < 0.05$) than False-CAB and False-Organic in the false information tasting segment, but False-Conventional had similar overall liking to False-Grass and False-Natural ($P > 0.05$). White et al. (2003) reported that negativity bias is often found because researchers ask panelists about subjects with a negative reputation. In the present study, Conventional beef was included as a treatment to represent conventionally raised beef and was described with phrases like "conventionally raised", "commercial feed yard", "growth promotants", "β-agonists", "steroidal implants", and "fed sup-therapeutic levels of antibiotics". Moreover, consumers associated conventionally raised beef with "administered antibiotics, growth promotants, or hormones", "fed animal by-products", and "raised in confinement" in their pre-trial questionnaire. These particular phrases may not necessarily have positive connotations with consumers, and the power of negativity bias could be reflected in consumer scores, as Abidoye et al. (2011) found that consumers value traits such as "no growth promotants" and "grass-fed".

Results from the consumer evaluations of eating quality during Experiment 2 can be found in Table 6. Although mean scores and acceptability percentages were somewhat higher in Experiment 2 compared to Experiment 1, when samples were evaluated in a blind testing format, results generally followed similar trends to those observed in Experiment 1. In the second segment of Experiment 2, Informed-Natural and Informed-CAB were rated more tender ($P < 0.05$) than all other treatments. There was no difference in tenderness between Informed-Grass, Informed-Conventional, and Informed-Organic ($P > 0.05$). There was no difference in tenderness scores in the blind testing segment

Table 6. Consumer (n = 120) palatability ratings, acceptability percentages, and willingness to pay for blind and true informed testing of top loin samples in Experiment 2.

Treatment[1]	Tenderness[2]	Juiciness[2]	Flavor liking[2]	Overall liking[2]	Tenderness, %	Juiciness, %	Flavor liking, %	Overall liking, %	$/lb.
Blind Testing									
CAB	58.2^{abc}	56.9^{ab}	52.4^{bc}	53.5^{bcd}	73.3^{bcd}	73.3^{bcd}	70.4^{d}	77.1^{bc}	9.08^{cd}
Grass	52.5^{cd}	54.0^{ab}	44.2^{d}	47.2^{de}	74.8^{bc}	74.8^{bc}	64.8^{d}	64.1^{de}	7.63^{de}
Natural	61.0^{ab}	59.8^{ab}	59.0^{ab}	59.3^{ab}	79.8^{ab}	79.8^{ab}	84.6^{b}	81.9^{b}	10.00^{bc}
Organic	46.3^{d}	57.4^{ab}	46.7^{cd}	44.5^{e}	77.5^{b}	77.5^{b}	62.5^{d}	59.4^{e}	6.83^{e}
Conventional	52.8^{cd}	52.6^{bc}	50.2^{cd}	52.7^{bcd}	70.0^{bcd}	70.0^{bcd}	71.2^{d}	73.7^{bcd}	8.26^{cde}
True Informed Testing									
Informed-CAB	62.4^{a}	57.8^{ab}	64.3^{a}	64.8^{a}	80.7^{ab}	80.7^{ab}	94.1^{a}	94.4^{a}	12.23^{a}
Informed-Grass	53.4^{bcd}	52.1^{bc}	50.2^{cd}	54.2^{bc}	65.4^{cd}	65.4^{cd}	69.5^{d}	71.0^{cde}	8.96^{cd}
Informed-Natural	63.1^{a}	60.6^{a}	62.6^{a}	65.1^{a}	88.0^{a}	88.0^{a}	86.1^{b}	92.6^{a}	11.67^{ab}
Informed-Organic	45.6^{d}	53.2^{abc}	49.0^{cd}	49.2^{cde}	74.0^{bc}	74.0^{bc}	68.6^{d}	67.8^{cde}	8.79^{cd}
Informed-Conventional	49.6^{d}	45.4^{c}	49.7^{cd}	51.8^{cd}	61.6^{d}	61.6^{d}	74.5^{cd}	72.1^{bcd}	7.94^{de}
P–value	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
SEM	3.38	3.27	3.46	3.26	4.52	6.21	6.99	5.33	0.88

[a-e]Within a column, least squares means without a common superscript differ ($P < 0.05$).

[1]Treatments: CAB = Certified Angus Beef; Grass = Local Grass Fed; Natural = Grain Fed Natural, Conventional = USDA Select.

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

between CAB, Grass, and Conventional, but consumers scored Informed-CAB more tender than Informed-Grass and Informed-Conventional. These results align with Wilfong et al. (2016) that showed brand declaration lifted scores for CAB and Angus Select to a point of differentiation from Choice and Select, respectively, when no difference existed during blind testing. Consumers rated Informed-Natural juicier than Informed-Grass and Informed-Conventional ($P < 0.05$). Consumers liked the flavor of Informed-CAB and Informed-Natural more than all other treatments ($P < 0.05$), which did not differ ($P > 0.05$). A similar trend as flavor liking was observed for overall liking for all treatments ($P < 0.05$).

Table 7 shows the changes in consumer ratings of palatability traits due to false treatment disclosure (Select steaks accompanied by treatment descriptions) and true treatment disclosure (steaks from each treatment accompanied by matching treatment descriptions). In Experiment 1, false disclosure resulted in a 13.5 unit decrease and a 17.9 unit increase for tenderness of Natural and Organic, respectively ($P < 0.01$). False disclosure also decreased the juiciness of Natural by 13.0 units ($P < 0.01$). Lastly, false treatment disclosure caused a boost ($P < 0.01$) in flavor liking scores by 16.5 and 20.5 units for Grass and Organic, respectively, which appeared to also drive overall liking up for both Grass and Organic ($P < 0.01$) by nearly 15 to 20 units. Johansson et al. (1999) reported that panelists rated tomatoes more favorably for sensory attributes when they were told the tomatoes were grown organically, showing a potential psychological bias toward organic foods. Goss et al. (2002) found that when consumers were given positive descriptions about Natural beef, previously indifferent consumers changed to having a positive attitude, yet the tenderness and juiciness of False-Natural decreased compared to Natural from the blind tasting segment. Although this phenomenon could be partially explained by the inherent palatability differences between Natural and Conventional (i.e., Top Choice vs. Select), the tenderness and juiciness of False-CAB did not change ($P > 0.05$) and the flavor liking of False-CAB actually increased ($P < 0.05$) when there was no change in the flavor liking of False-Natural ($P > 0.05$).

The changes in consumer ratings of palatability traits due to true treatment disclosure (actual treatment steaks accompanied by matching treatment descriptions) are also shown in Table 7. There was no change in tenderness scores from the samples tested in the blind segment to the samples that were tested during the true informed segment ($P > 0.05$). Consumers scored Informed-Conventional 7.1 units lower ($P < 0.05$) in the informed segment as opposed to the blind segment, but no other differences in juiciness scores were observed between the 2 segments ($P > 0.05$). True treatment disclosure resulted in an increase in flavor liking scores for CAB and Grass by 11.9 and 6.0 units, respectively ($P < 0.05$). As a result, overall liking scores increased for both CAB and Grass, but also for Natural by 11.3, 7.0, and 5.8 units, respectively. Overall liking scores did not change for Organic or

Table 7. Change in consumer ratings of palatability traits due to false treatment disclosure in Experiment 1 (n = 120) and true treatment disclosure in Experiment 2 (n = 120).

Treatment[1]	Tenderness difference	Juiciness difference	Flavor difference	Overall liking difference
False disclosure				
CAB	-1.4	-6.9	8.1*	6.3†
Grass	0.5	-4.9	16.5**	14.6**
Natural	-13.5**	-13.0**	-3.2	-4.6
Organic	17.9**	-0.4	20.5**	19.8**
Conventional	-0.2	-3.6	1.8	0.0
True disclosure				
CAB	4.2	0.9	11.9**	11.3**
Grass	0.9	-1.9	6.0*	7.0*
Natural	2.1	0.8	3.6	5.8*
Organic	-0.6	-4.2	2.3	4.8
Conventional	-3.2	-7.1*	-0.5	-0.9

† denote that a mean differs from 0 ($P < 0.10$).

* denote that a mean differs from 0 ($P < 0.05$).

** denote that a mean differs from 0 ($P < 0.01$).

[1]Treatments: CAB = Certified Angus Beef; Grass = Local Grass Fed; Natural = Grain Fed Natural, Conventional = USDA Select.

Table 8. Percentage of beef top loin steaks categorized into perceived quality levels during blind and false informed testing by consumer panelists in Experiment 1 (n = 120).

Treatment[1]	Unsatisfactory	Good everyday quality	Better than everyday quality	Premium quality
Blind Testing				
CAB	11.5[bcd]	34.2[de]	42.4[ab]	10.9[bc]
Grass	28.2[a]	50.0[ab]	13.2[e]	7.7[bc]
Natural	6.6[cd]	30.0[e]	46.6[a]	15.7[ab]
Organic	28.5[a]	52.1[a]	14.1[e]	4.6[c]
Conventional	15.5[b]	48.7[abc]	26.8[cd]	8.1[bc]
False Informed Testing				
False-CAB	4.9[d]	39.2[bcde]	29.8[cd]	24.9[a]
False-Grass	14.2[bc]	45.4[abcd]	30.1[bcd]	9.4[bc]
False-Natural	14.9[b]	36.7[cde]	31.5[bcd]	15.7[ab]
False-Organic	11.8[bcd]	34.7[de]	38.9[abc]	13.5[b]
False-Conventional	13.3[bc]	49.6[ab]	26.7[d]	9.3[bc]
P–value	< 0.01	< 0.01	< 0.01	< 0.01
SEM	4.04	4.59	4.99	4.13

[a-e] Within a column, least squares means without a common superscript differ ($P < 0.05$).

[1]Treatments: CAB = Certified Angus Beef; Grass = Local Grass Fed; Natural = Grain Fed Natural, Conventional = USDA Select.

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

Conventional samples between the blind and informed segments ($P > 0.05$). These results align with Wilfong et al. (2016) that showed brand disclosure of CAB had a significant percentage increase in juiciness, flavor liking, and overall liking scores compared to results from their blind testing, while there was no change in palatability scores between blind and informed testing for Select. Consumers have associated words like natural, grass-fed, local, and organic with being safer, healthier, more nutritious, and more environmentally friendly (Abidoye et al., 2011; Managi et al., 2008; Onozaka et al., 2010;), which may have helped elevate overall liking scores of Grass and Natural. Yet, surprisingly, consumers rated Organic similarly between the blind and informed segments. Levin and Gaeth (1988) showed that ground beef with positive framing (i.e., labeling ground beef based on its lean percentage, as opposed to its fat percentage) was more favorable to consumers, but the magnitude of the information framing effect diminished when consumers actually ate the ground beef samples. This could explain why despite having positive preconceived ideas about organic beef, consumers still scored Organic similarly between the 2 segments in the current study.

Consumer acceptability

Treatment impacted acceptability of tenderness, juiciness, flavor and overall liking in the blind testing segment of Experiment 1 ($P < 0.01$; Table 5). Tenderness acceptability of Natural and CAB were similar and greater ($P < 0.05$) than Organic and Conventional. Natural and CAB had acceptable juiciness more often than Organic ($P < 0.05$). Natural and CAB had a greater proportion of acceptable samples ($P < 0.05$) for flavor than Grass and Organic; however, overall acceptability was similar ($P > 0.05$) for Natural, CAB, and Conventional, which were all greater ($P < 0.05$) than Grass and Organic.

In the second segment of Experiment 1, there were no differences in tenderness acceptability between treatments ($P > 0.05$). A greater proportion of consumers considered False-Organic more acceptable for juiciness than False-Conventional ($P < 0.05$), but no other differences in juiciness acceptability were observed. A greater proportion of consumers considered False-CAB acceptable than False-Grass and False-Conventional for flavor liking ($P < 0.05$), but False-Organic and False-Natural were similar to False-CAB for flavor acceptability. No differences were detected between treatments for overall acceptability ($P > 0.05$).

A smaller proportion of consumers considered False-CAB and False-Natural acceptable for tenderness and juiciness than the corresponding samples served during the blind testing segment ($P < 0.05$). No other treatments differed in tenderness or juiciness

Table 9. Percentage of beef top loin steaks categorized into perceived quality levels during blind and true informed testing by consumer panelists in Experiment 2 (n = 120).

Treatment[1]	Unsatisfactory	Good everyday quality	Better than everyday quality	Premium quality
Blind Testing				
CAB	19.4[ab]	49.2[abc]	25.0[cde]	5.0[cd]
Grass	28.6[a]	47.5[abc]	17.5[de]	5.1[cd]
Natural	8.0[cd]	47.1[abc]	34.5[abc]	8.9[bc]
Organic	29.4[a]	52.5[ab]	15.0[e]	2.1[d]
Conventional	17.0[b]	58.8[a]	19.3[de]	3.6[cd]
True Informed Testing				
Informed-CAB	1.6[e]	39.2[c]	37.5[ab]	19.9[a]
Informed-Grass	21.0[ab]	47.5[abc]	22.5[de]	7.3[bcd]
Informed-Natural	6.4[de]	38.1[c]	39.8[a]	13.6[ab]
Informed-Organic	21.9[ab]	45.8[bc]	25.8[bcd]	5.1[cd]
Informed-Conventional	15.3[bc]	55.8[ab]	23.9[cde]	3.7[cd]
P–value	< 0.01	< 0.01	< 0.01	< 0.01
SEM[2]	4.50	4.57	4.50	5.53

[a-e] Within a column, least squares means without a common superscript differ ($P < 0.05$).

[1]Treatments: CAB = Certified Angus Beef; Grass = Local Grass Fed; Natural = Grain Fed Natural, Conventional = USDA Select.

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

acceptability between the blind and false information segments. A greater proportion of consumers considered False-Grass and False-Organic acceptable for flavor and overall liking than the corresponding samples served during the blind testing segment ($P < 0.05$). No other treatments differed in flavor liking or overall acceptability between the blind and false information segments. Gifford and Bernard (2005) found that when consumers were given a survey in which organic treatments were explained, 40% more consumers reported they were more likely to purchase organic products. Positive framing and describing the benefits of organic methods was more effective on consumers. In the present study, when consumers were given a description of organic beef regardless if the sample was truly organic, it influenced palatability scores and acceptability, demonstrating the effect of positive framing.

The effects of treatment on the proportion of consumers that found tenderness, juiciness, flavor liking, and overall liking acceptable for both the blind testing and true information testing segments of Experiment 2 can be found in Table 6. In the blind testing segment there were no differences in tenderness or juiciness acceptability ($P > 0.05$), but a greater proportion of Natural samples were acceptable for flavor liking than all other treatments ($P < 0.05$). A greater percentage of consumers considered the Natural and CAB samples acceptable overall than Grass and Organic, but Conventional had similar overall acceptability to Natural and CAB.

In the second segment (true informed testing), a greater proportion of consumers considered Informed-Natural greater ($P < 0.05$) than Informed-Grass, Informed-Organic, and Informed-Conventional for tenderness and juiciness acceptability, but Informed-Natural was not different ($P > 0.05$) from Informed-CAB. A greater percentage of consumers considered Informed-CAB acceptable for flavor liking compared to all other treatments ($P < 0.05$); Informed-Natural and Informed-Conventional were intermediate for flavor acceptability, and Informed-Grass and Informed-Organic had lower flavor acceptability than any other treatment. Lastly, a larger proportion of consumers considered Informed-CAB and Informed-Natural acceptable overall ($P < 0.05$) compared to the remaining treatments, which did not differ for overall acceptability ($P > 0.05$).

A greater proportion of consumers considered Informed-CAB acceptable for flavor and overall liking than the corresponding samples served during the blind testing segment ($P < 0.05$). A greater percentage of consumers considered Informed-Natural acceptable overall compared to the corresponding samples served during the blind testing segment ($P < 0.05$). No other treatments differed in tenderness, juiciness, flavor liking, or overall acceptability between the blind and true information segments.

Consumer willingness to pay

The results for consumer WTP in Experiment 1 can be found in Table 5. In the blind testing segment, consumers were willing to pay more for Natural and CAB compared to Grass and Organic ($P < 0.05$), but Conventional garnered similar willingness to pay as CAB. In the second segment of Experiment 1, consumers were willing to pay more ($P < 0.05$) for the False-CAB and False-Organic samples; however, WTP for False-Organic was similar ($P > 0.05$) to False-Natural. Willingness to pay increased ($P < 0.05$) from segment 1 to segment 2 for False-CAB, False-Grass, and False-Organic compared to WTP of those samples in the blind testing segment.

Consumer WTP for samples served during Experiment 2 can be found in Table 6. Consumers were willing to pay more ($P < 0.05$) for the Natural samples than the Grass and Organic. In the blind testing segment, there was no difference ($P > 0.05$) between consumer WTP for Natural, CAB and Conventional. During the true informed testing segment, consumers were willing to pay more for Informed-CAB and Informed-Natural samples compared to the other three treatments, while WTP of the other three treatments did not differ ($P > 0.05$). Willingness to pay increased ($P < 0.05$) from segment one to segment two for Informed-CAB and Informed-Organic.

Several studies have shown consumers are willing to pay premiums for natural, organic, or meat produced through non-conventional production practices (Acevedo et al., 2006; Grannis and Thilmany, 2000). Abidoye et al. (2011) found consumers value grass-feeding and raising cattle without growth promotants and are willing to pay a premium for both attributes. Much like the current results, Umberger et al. (2009b) reported that consumers were willing to pay more for grain-fed beef compared to grass-fed beef during blind taste testing. The authors also found a greater proportion of consumers were willing to pay for grass-fed beef as they were provided with additional production practices and health information without tasting the product (Umberger et al., 2009b). However, when consumers were given product information and tasted the product, consumer preference and willingness to pay shifted away from grass-fed and toward grain-fed beef (Umberger et al., 2009b). Similarly, Wang et al. (2011) reported consumers chose conventional over natural or organic meat products when they were not given production information, but as consumers received production information, consumers chose natural more often than conventional or organic. In addition, consumers' willingness to pay for both natural and organic meat increased as they received information about natural and organic production practices (Wang et al., 2011), which support the findings for WTP during the informed testing segments of the current study. Curtis (2014) found product credence attributes, such "naturally raised/produced", "produced following environmentally friendly practices", "organic", "feed type", "certified as following humane animal treatment standards", and "origin" all had a positive and significant effect on consumer willingness to pay for beef steak products, but product appearance traits, such as marbling, texture, and brand also had a positive influence on consumer WTP.

Perceived quality levels

The effects of treatment on the percentage of steaks classified into perceived quality levels for both the blind testing and false information testing segments of Experiment 1 can be found in Table 8. Consumers in the blind segment considered Grass and Organic "Unsatisfactory" more often than any other treatment ($P < 0.05$). Organic, Conventional, and Grass samples were considered "Good everyday quality" more often ($P < 0.05$) than CAB or Natural samples. Over forty percent of consumers considered CAB and Natural as "Better than everyday quality", which was a greater proportion than Conventional, Organic, and Grass. Natural samples were considered "Premium quality" more often ($P < 0.05$) than Organic, but there was no difference between CAB, Grass, and the Conventional samples ($P > 0.05$). In the second segment, consumers classified False-CAB as "Unsatisfactory" less often ($P < 0.05$) than False-Grass, False-Natural, or False-Conventional. False-Conventional were classified as "Good everyday quality" more often ($P < 0.05$) than False-Natural or False-Organic. A greater percentage ($P < 0.05$) of consumers considered False-Organic "Better than everyday quality" in comparison to False-Conventional. Lastly, a greater percentage ($P < 0.05$) of consumers classified False-CAB as "Premium quality" compared to False-Grass, False-Conventional, and False-Organic.

False-CAB was classified as "Better than everyday quality" less than CAB from the blind segment but was classified as "Premium quality" more often than CAB ($P < 0.05$). False-Grass was classified as "Unsatisfactory" less during the false information segment than Grass in the blind segment, shifting a greater proportion of consumers to classify False-Grass as "Better than everyday quality" compared to Grass from the blind segment ($P < 0.05$). A similar trend was observed for False-Organic, but the proportion of False-Organic that were classified at "Premium Quality" was also greater than Organic from the blind segment ($P < 0.05$). The opposite trend was observed for False-Natural, as the percentage of samples categorized as "Unsatisfactory" increased, while the percentage categorized as "Better than everyday quality" decreased compared to the blind segment ($P < 0.05$).

The effects of treatment on the percentage of steaks classified into perceived quality levels for both the blind testing and true information testing segments of Experiment 2 can be found in Table 9. A higher proportion of Organic, Grass, and CAB were classified as "Unsatisfactory" in comparison to Natural in the blind segment ($P < 0.05$). Conversely, Natural samples were categorized as "Better than everyday quality" more often ($P < 0.05$) than Grass, Organic, and Conventional. Following a similar trend, Natural was considered "Premium quality" more often ($P < 0.05$) than Organic samples. During the true informed segment, Informed-Grass, Informed-Organic, and Informed-Conventional had a greater percentage ($P < 0.05$) of samples in the "Unsatisfactory" category compared to Informed-CAB and Informed-Natural. There was also a higher percentage ($P < 0.05$) of Informed-CAB and Informed-Natural placed in the “Better than everyday quality” category compared to Informed-Conventional and Informed-Grass. There was also a greater percentage ($P < 0.05$) of Informed-CAB and Informed-Natural receiving the “Premium quality” designation compared to Informed-Organic and Informed-Conventional.

Very few changes in classification were observed between the blind and informed testing segments. However, the percentage of Informed-CAB samples classified as “Unsatisfactory” drastically decreased ($P < 0.05$), while the proportion classified as “Better than everyday quality” and “Premium quality” both increased ($P < 0.05$). A greater percentage of Informed-Natural were classified as “Better than everyday quality” compared to Natural in the blind segment ($P < 0.05$), but no other shifts in quality classification were observed as a result of the true treatment disclosure. In a similarly structured study, Wilfong et al. (2016) also saw a substantial decrease in the percentage of CAB classified as “Good everyday quality” with a concurrent increase in the percentage classified as “Premium quality”.

Correlations

Pearson correlation coefficients were generated to assess the relationships between consumer sensory scores for the informed (true) samples. Consumer overall liking was correlated ($P < 0.05$) with consumer tenderness ($r = 0.83$) and juiciness ratings ($r = 0.~75$), but most highly correlated with flavor liking ($r = 0.90$).

Similar coefficients were generated to quantify the relationships between consumer sensory scores during the blind testing segment. Overall liking was related ($P < 0.05$) to all traits, including objective measures of color. Overall liking was again most strongly related ($r = 0.87$) to flavor liking of the three palatability traits, and despite correlations between overall liking and all 3 palatability traits, the coefficients were smaller for samples evaluated during the blind testing format, especially the coefficients for tenderness with overall liking ($r = 0.72$ vs. $r = 0.83$) and juiciness with overall liking ($r = 0.53$ vs. $r = 75$).

The current results were not unexpected as the previous reports of beef eating quality for U.S. consumers align with these coefficients for grass-fed beef (Crownover et al., 2017; Hardcastle et al., 2018) and grain-fed beef (Corbin et al., 2015; Hunt et al., 2014). These data also support the relationship of tenderness, flavor, and juiciness conjointly contributing to the consumer perception of overall liking as reported by Neely et al. (1998).

Conclusion

When consumers evaluated samples in segment 1, they rated the Natural and CAB samples more tender and juicier than the other three treatments, and Organic was the least tender. Flavor and overall liking were greater for Natural and CAB steaks, while Conventional was intermediate, and flavor and overall liking were lowest for Grass and Organic. When consumers received Select samples representing the 5 treatments, false disclosure decreased tenderness and juiciness of Natural, increased flavor liking of CAB, and increased tenderness, flavor liking, and overall liking of Organic. True treatment disclosure increased flavor liking and overall liking of CAB and Grass, increased overall liking of Natural, and decreased juiciness of Conventional. False treatment disclosure also increased the WTP of CAB, Grass, and Organic compared to values garnered in the blind testing segment. These results indicate consumers’ perception of eating quality can be influenced by quality differentiated brand names and labeling claims, particularly claims related to production practices. Moreover, consumers are willing to pay more for products they perceive to have superior eating quality, and providing product information has the ability to increase WTP of branded product and product with added production claims, but not conventional beef.

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