

Consumer Topics

4: IDENTIFYING CONSUMER PREFERENCE FOR BEEF RAISED WITH DIFFERENT PRODUCTION SYSTEMS

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Objectives: Objectives of this study were to 1) evaluate meat quality characteristics, and 2) identify consumer palatability and label preferences for beef raised in different production systems.

Materials and Methods: Beef striploins (n=72) were collected from cattle raised using four different production systems: 1) no technology (NA; no antibiotics or growth promotants); 2) non-hormone treated (NHTC; NA plus therapeutic antibiotics); 3) implant (IMPL; NHTC plus implants); and 4) implant plus a beta-agonist (IMBA; IMPL plus ractopamine-HCl). Cattle were slaughtered at a commercial facility and marbling scores were obtained prior to striploin collection. During fabrication the anterior end of striploins were squared off and the slice removed was frozen for analysis of percent crude fat. Steaks (2.54 cm) were fabricated from striploins, vacuum packaged, aged 14 d, and designated for WBSF and consumer panel analysis. To determine the influence of production information on consumer preferences, untrained consumer panelists (n=105) were recruited from the surrounding areas of St Paul, MN for three consecutive panels: Blind (Panel 1; samples provided with no production information); Disclosed without Meat (Panel 2; only the production description provided); and Disclosed with Meat (Panel 3; samples and production description provided). Panelists were fed repeated samples of each of the four treatments and were instructed to identify their most and least preferred sample. The relative preference of each sample was analyzed to determine percent share of preference (SOP) per treatment for comparison using a percentage scale.

Results: The marbling score and ether extractable fat percentage of NA and NHTC did not differ ($P > 0.05$) but were greater ($P \leq 0.05$) than IMPL and IMBA, which were similar ($P > 0.05$). Steaks from NA and NHTC treatments did not differ ($P > 0.05$) for WBSF though were more tender ($P \leq 0.05$) than IMPL and IMBA, which were not different ($P > 0.05$). Percent cook loss was reduced ($P \leq 0.05$) for NHTC versus IMPL and IMBA which were not different ($P > 0.05$). Further, a reduction ($P \leq 0.05$) in percent cook loss was detected for NA compared to IMPL but did not differ ($P > 0.05$) from IMBA. In Panel 1, when no information was provided, NA was most preferred ($P \leq 0.05$) and IMBA was least preferred ($P \leq 0.05$) while NHTC and IMPL were intermediate and similar ($P > 0.05$). When asked to select the most and least preferred production descriptions in Panel 2, all SOP differed ($P \leq 0.05$) with NA most preferred followed by NHTC, IMPL, and IMBA. All samples differed ($P \leq 0.05$) when information was disclosed and meat was consumed in Panel 3 but NHTC was most preferred followed by NA, IMPL and IMBA. Pairwise comparisons between Panel 1 and 3 revealed that disclosing production information resulted in a lift ($P \leq 0.05$) in SOP for NA and NHTC and a decline ($P \leq 0.05$) for IMPL and IMBA.

Conclusion: Treatments utilizing growth promoting implants with and without beta-agonist increased WBSF, which may be detectable by untrained consumer panelists as natural treatments captured greater SOP in both blind and disclosed panels. When production information was disclosed and palatability was assessed, NHTC was the most preferred followed by NA, indicating that when information is provided consumers are accepting of meat from an animal that may have been treated with an antibiotic in the event of illness.

Keywords: beef, consumer, meat quality, shares of preference, technology

Consumer Topics

5: EFFECTS OF MARBLING TEXTURE ON CONSUMER PALATABILITY RATINGS OF BEEF STRIP LOIN STEAKS

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Objectives: To determine the effect of marbling texture (fine, medium, and coarse) on consumer sensory and visual ratings of beef strip loin steaks of three USDA quality grades.

Materials and Methods: Beef strip loins (n = 117; 39/grade) were selected to equally represent three marbling texture categories (fine, medium, and coarse) within three quality grades [Top Choice (Modest⁰⁰ – Moderate¹⁰⁰ marbling), Low Choice, and Select] based on visual appraisal of marbling texture. For selection, 75% of the marbling in the ribeye had to meet the USDA-AMS-LS-SB-02 marbling texture reference for the texture category. Prior to analysis, each strip loin was aged for 21 d and fabricated into 2.5 cm steaks, vacuum packaged, and frozen at -20°C. Each steak was cooked to 71°C on clamshell grills for consumer panel analysis. After cooking, each steak was cut into 2.5×1×1 cm cubes and two cubes were served to each panelist. Untrained consumer panelists (n = 104) evaluated nine samples, one from each treatment, for tenderness, juiciness, flavor liking, and overall liking on 100 mm line scale, and rated each trait as acceptable or unacceptable. Each consumer was also asked to visually rate the appearance of a steak from each treatment using a digital survey on an electronic tablet. Pictures of each steak were edited to 2.5×6.4 cm dimensions of the center of the steak to remove any external fat or muscling differences. Consumers rated their preferences for the appearance of each steak as well as how likely they were to purchase the steak pictured on line scales with verbal anchors at each end and midpoints. Data were analyzed as a completely randomized design with a 3×3 factorial arrangement with marbling texture, quality grade, and their interaction as fixed effects.

Results: There were no marbling texture × quality grade interactions ($P > 0.05$) for all traits evaluated. Additionally, marbling texture had no effect ($P > 0.05$) on palatability traits, as consumers rated all texture groups (fine, medium, and coarse) similar for tenderness, juiciness, and flavor. When asked if samples were acceptable for each trait, consumers rated a similar ($P > 0.05$) percentage of samples from each texture treatment as acceptable. Likewise, marbling texture did not affect ($P > 0.05$) the percentage of strip loin steaks rated as unsatisfactory, everyday, better than everyday, or premium quality. When asked to visually rate the steaks, consumers rated all marbling texture treatments similar ($P > 0.05$) for the desirability of the appearance of the steak as well as for purchase intent. Low Choice steaks were rated higher ($P < 0.05$) than Select steaks for tenderness, flavor liking, and overall liking. Consumers rated Low Choice steaks similar ($P > 0.05$) to Top Choice steaks for all palatability traits evaluated. When asked to rate samples as acceptable or unacceptable for tenderness, juiciness, and overall liking, there were no differences ($P > 0.05$) between quality grade treatments; however, a lower percentage of Select samples were rated as acceptable ($P < 0.05$) for flavor than either Top or Low Choice steaks.

Conclusion: These results indicate marbling texture does not impact consumer ratings of tenderness, juiciness, flavor liking or overall liking of beef strip loin steaks from the evaluated quality grades. Moreover, consumers did not exhibit a visual preference for steaks of differing marbling texture or marbling levels.

Keywords: Beef, Consumer, Marbling texture, Palatability, Quality grade

Consumer Topics

6: FREEZING TEMPERATURE AND THAWING METHODS IN SENSORY QUALITY OF BEEF STRIP LOIN STEAKS

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Objectives: Freezing is one of the most important methods to preserve meat and meat products. However, it may affect some of the quality traits, depending on freezing rate, frozen storage conditions and thawing methods. For this reason, the objective of this study was to investigate the descriptive sensory profile (QDA) of beef strip loin steaks stored at -10°C or -20°C and thawed after 1 month by refrigerator temperature (4°C/~24 hours), ambient temperature (20°C/~4 hours) or microwave, comparing to non-frozen samples.

Materials and Methods: Each strip loin (n = 3) was cut in 2.5cm thick steaks and destined for one of the seven treatments. Steaks were weighed before freezing and after thawing, as well after cooking to calculate weight losses. After thawing (considered 4°C) or for fresh meat, the samples were cooked in an electric oven until reaching 71°C. Eleven trained assessors were selected and evaluated the samples in monadic form and according to a complete balanced block design. The intensity of sixteen descriptors chosen during the training sessions was evaluated using a linear scale of 9 cm (unstructured), anchored at the extremities by weak, little or none to the left and strong and much to the right. The data were analyzed using the GLM procedure and the means were compared by the Tukey test with the aid of the SAS software.

Results: Microwave thawed samples, independent of freezing temperature storage, showed the highest values of thawing loss (P<0.05; ~11%), while thawing at 4°C or 20°C had similar losses (P>0.05; ~2%). There was no difference in weight losses during cooking between either for temperature of storage or thawing method (P>0.05; ~21%). For the appearance attributes (internal brown color, degree of doneness, apparent juiciness and crumbling) only the apparent juiciness was affected (P<0.05) by the treatments, where samples thawed by microwave presented a drier appearance (2.70 and 3.13 at -10°C and -20°C, respectively). There were no differences (P>0.05) between treatments for aroma attributes (roast beef, cooked beef, metallic and rancid). For flavor attributes (roast beef, cooked beef, metallic and rancid) the assessors found less rancidity (P<0.05; 0.16) for samples frozen at -20°C and thawed in refrigeration (4°C), when compared to the other treatments (~0.65). The assessors verified a difference (P<0.05) between the treatments for fibrosity, one of the texture attributes (initial tenderness, initial juiciness, chewiness and fibrosity), where the non-frozen sample had the highest values (4.45), while the samples frozen at -10°C and thawed at ambient temperature and refrigeration showed the lowest values (2.81 and 3.12, respectively).

Conclusion: The results indicate that the frozen storage temperature, as well the methods used in the thawing can affect some sensory attributes, however they would not be able to compromise the overall quality of beef.

Keywords: Beef flavor, frozen storage, Microwave cooking, Quantitative Descriptive Analysis, sensory analysis

Consumer Topics

7: THE FLAVOR AND TEXTURE ATTRIBUTES OF GROUND BEEF

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Objectives: Ground beef comprises between 50 and 60% of the beef consumed in the United States and is manufactured from beef trimmings from either commodity, grain-fed beef or lean trimmings from older, mature cows and bulls. Examining the impact of final grind, forming, fat/source content, patty thickness, cooking, and holding on ground beef patty descriptive flavor and texture attributes and aromatic volatile chemical compounds provides a method for understanding factors that drive ground beef flavor and texture differences.

Materials and Methods: Ground beef from grain-fed and mature cattle were selected at two different fat levels. The ground beef was coarse ground and then segmented into 3 final grinds treatments (bowl chopped, 0.95 cm grind, 0.64 cm grind) and then formed into patties by hand or by machine at either 0.64 cm or 2.54 cm thickness. The patties were cooked using a dry heat cooking method (a flat solid) or a steam cooking method (clam-shell grill) to an internal cook temperature endpoint of 70°C. Hold time was also evaluated at 0, 1, and 3 hours in a steam table. Two trained descriptive sensory attribute panels from Texas A&M University (n = 288) and Kansas State University (n = 218) evaluated patties for flavor and texture descriptive attributes.

Results: Patty thickness impacted flavor attributes with thicker patties having more (P < 0.05) beef identity, overall sweet, brown/roasted, fat like flavor attributes; umami, salty, bitter and sweet basic tastes; and particle size, and initial juiciness texture attributes than thinner patties. Ground beef patties with higher fat content, 20 versus 5% lipid, had higher (P < 0.05) levels of beef identity flavor attribute and umami basic taste and ground beef patties manufactured using grain-fed beef versus mature beef had more (P < 0.05) beef identity, and brown/roasted flavor attributes. Grind size impacted patty flavor and texture attributes but not to as great of an extent as patty thickness and meat source. Ground beef patties that were ground to either 0.64 cm or 0.95 cm final grind size had more (P < 0.05) fat-like flavor attributes. The bowl chopped and final grind size of 0.95 cm were (P < 0.05) more springy and harder. Cooking impacted flavor and texture attributes. Patties cooked on the George Foreman grill had more (P < 0.05) oxidized flavors, which were magnified when 0.64 cm thick patties were cooked, than patties cooked on a flat grill. Hand formed patties had more (P < 0.05) beef identity, brown/roasted, bloody serummy, fat-like flavor attributes and umami and sweet basic tastes than machine formed patties. Holding patties in a steam table for up to 3 h mainly affected oxidative flavors, but had minimal effects on flavor and texture attributes across all treatments (P < 0.05). In a partial least square regression bi-plot, thick ground beef patties from commercial grain-fed sources with 20% fat and bowl chopped or fine ground were more closely clustered with the positive flavor attributes including beef identity, brown/roasted, buttery, and fat-like flavor attributes; initial juiciness; and sweet, salty and umami basic tastes than the other treatments.

Conclusion: Selecting specific ground beef patty manufacturing and cooking methods can be used to improve the flavor traits of patties and should be used to maximize consumer acceptance.

Keywords: Beef flavor, ground beef, Sensory

Consumer Topics

8: CONSUMER PERCEPTION OF BEEF PALATABILITY ALTERED BY BRAND RECOGNITION

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Objectives: The objective of this study was to evaluate the differences of beef palatability trait scores when consumers were made aware of brands representing various production systems.

Materials and Methods: Strip loins were selected to represent a Grain-Fed Natural (Natural), Certified Angus Beef (CAB), Local Grass Fed (LGF), USDA Select (Select), and USDA Certified Organic (Organic) production systems. After 21 d of storage, strip loins were cut into 2.5 cm thick steaks and stored at -20°C until analysis. Thawed samples were cooked on a belt grill to a medium degree of doneness (71°C) and evaluated by consumers (n = 120) for tenderness, juiciness, flavor liking, and overall liking. Each trait was rated on a 100 mm verbally anchored line scale. Each panelist was served two, 1 cm x 1 cm, pieces per sample. Panelists were served steaks representing the five production system treatments without any knowledge of their identity (blind). Next, panelists were served five samples but were read a short description of each production system treatment before each sample (known). Differences between the results from the blind group responses and the known responses were calculated for the various palatability traits. Data were analyzed using the GLIMMIX procedure of SAS (version 9.4) with treatment as the fixed effect and panel as the random effect ($\alpha = 0.05$).

Results: During the blind panels, differences were found among production system treatments for tenderness, flavor and overall liking ($P < 0.01$). Natural and CAB samples were scored higher than all other treatments for tenderness, flavor and overall liking ($P < 0.05$). Organic was scored less for tenderness than both Select and LGF (46.25 vs. 52.83 and 52.52, respectively; $P < 0.05$), while both LGF and Organic were rated higher than Select for flavor and overall liking ($P < 0.05$). After treatment descriptions were read to the panelists, panelists increased their scores for all palatability traits for Natural and CAB, with each treatment scoring higher than any other production system. Additionally, LGF and Select rated higher in tenderness, flavor and overall liking than Organic ($P < 0.05$). When consumers were aware of the production system of the beef they were consuming, scores for tenderness and juiciness did not fluctuate from the blind panels ($P = 0.39$ and $P = 0.23$, respectively). However, CAB was rated 11.9 and 11.3 units greater ($P < 0.01$) for flavor liking and overall liking, respectively, when the treatments were known. Likewise, consumers scored LGF 6.0 and 7.0 units greater ($P < 0.05$) for flavor liking and overall liking, respectively. Moreover, scores for Natural overall liking increased ($P < 0.05$) by 5.8 units when consumers knew the treatments.

Conclusion: These results indicate brand recognition may have significant impact on consumer perception of beef palatability. Most notably, Natural and CAB rated the highest among treatments during the blind panel, and benefited the most from treatment disclosure. Overall, verbal descriptions tended to increase consumer acceptability, particularly for flavor and overall liking. The Select treatment group was the only treatment with negative impacts.

Keywords: beef, brands, consumer preference, sensory analysis

Consumer Topics

9: EFFECTS OF LABELING AND CONSUMER HEALTH TRENDS ON PREFERRED GROUND BEEF COLOR CHARACTERISTICS, FAT CONTENT, AND PALATABILITY IN SIMULATED RETAIL DISPLAY.

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Objectives: Nutritional concerns and attempts to limit fat in the diet over the past decades have impacted the protein market, decreasing red meat consumption as well as prompting the advent of lean and extra lean ground beef. Such lean blends of ground beef may suffer in palatability, however, resulting in less satisfied consumers turning to other protein sources. While consumers are demanding lean ground beef, fatter blends may be more palatable. This study seeks to bridge the gap between perceived health and palatability by evaluating preferred fat content and instrumental color characteristics between labeled and unlabeled packages of ground beef in simulated retail display and comparing this data to preferred palatability characteristics in taste sampling.

Materials and Methods: Participants were asked to identify the relative importance of characteristics commonly used in purchasing ground beef (color, label, fat content, company, and price) and select a preferred package of ground beef from labeled and unlabeled sections consisting of 4%, 10%, 20%, and 27% fat content. Instrumental color data (CIE L*, a*, b*, hue, and chroma) and their main drivers (oxymyoglobin proportion) were also collected. Participants then completed a blind taste sampling of ground beef with variable fat contents as previously described and were asked to evaluate samples on juiciness, bind, beef flavor, off flavor, and overall impression. Data were evaluated through the Mixed Model procedure of SAS, version 9.4.

Results: Color, fat, and price were found to be significantly more important ($P < 0.05$) than label, which was significantly more important than company for package preference. No trend towards fatter or leaner blends was found between labeled and unlabeled selections, with 62.64% of participants selecting identical packages between the two sections. The 20% fat treatment was the most frequently selected product in both labeled and unlabeled sections, however the two leaner blends combined garnered more preferred selections than the two fatter blends (56.67% vs. 43.33%, respectively). Instrumental color data found significant trends towards a lighter product and increasing L* value with increasing fat content as well as decreasing oxymyoglobin proportion with increasing fat content. No significant differences were found between the blends for any trait in sensory taste evaluation.

Conclusion: These results suggest that while consumers have specific preferences when purchasing ground beef that can be replicated without a label using visual inspection alone, they are less discerning between cooked ground beef of different fat contents. This may explain the continued demand for lean ground beef, as consumers in this study found no significant differences in palatability between ground beef differing in fat content from 4% to 27%. Continued research comparing preferred fat content of ground beef in retail display with preferred fat content for palatability is encouraged to expand upon the findings of this study.

Keywords: color, consumer, fat content, ground beef, sensory

Consumer Topics

10: FRESH BEEF STEAK PURCHASING MOTIVATION IS AFFECTED BY DEMOGRAPHICS AND BEEF PREFERENCES OF CONSUMERS

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Objectives: A consumer study was conducted to measure the impact of demographics and beef preferences on purchasing motivators of fresh beef steaks.

Materials and Methods: Panelists were recruited in conjunction with a beef consumer panel in four cities in the United States. Consumers (n = 480; 120/city) were evenly distributed in Lubbock, Texas; Manhattan, Kansas; San Francisco, California; and Gainesville, Florida. Consumers were asked to evaluate the importance of purchasing motivators when buying fresh beef steaks on a 10-cm, verbally anchored line scale. The motivators included animal welfare (WEL); antibiotic use in the animal (ANT); brand of product (BRAND); color; diet of animal (corn, grass, vegetarian fed) (DIET); eating satisfaction claims (ex: guaranteed tender) (CLAIM); familiarity with cut (CUT); growth hormone use in the animal (HORM); local; natural or organic claims (NATORG); nutrient content (NUTR); packaging type (PACK); price; size, weight and thickness; and USDA grade (marbling). Demographics obtained included gender, household size, marital status, age, ethnic origin, annual household income and education level. Beef preferences identified included weekly beef consumption, most important palatability trait when eating beef, degree of doneness (DOD) preferred when eating beef, and meat product preferred for flavor. Statistical analyses were conducted using the procedures of SAS (Version 9.3; SAS Inst. Inc., Cary, NC). Treatment comparisons were tested for significance using PROC GLIMMIX with $\alpha = 0.05$.

Results: Traits including WEL, ANT, BRAND, color, DIET, HORM, local, NATORG, NUTR, PACK and price were of more ($P < 0.05$) importance to females than males. Married consumers put greater ($P < 0.05$) purchasing emphasis on ANT, DIET, CLAIM, CUT, HORM and local than single consumers. Californians had higher ($P < 0.05$) average ratings for WEL, ANT, color, DIET, HORM, local and NATORG, than all other states. Household sizes of >5 people placed more ($P < 0.05$) importance on BRAND, DIET, and NUTR than consumers from smaller households. Consumers with 1-2 people per household placed less ($P < 0.05$) importance on ANT and local purchasing motivators compared to larger households. Antibiotics, DIET, HORM, local and NATORG were more ($P < 0.05$) important to consumers over 60 years old than to consumers under 29 years old. Caucasian/White consumers placed less ($P < 0.05$) importance on BRAND, HORM, NATORG, NUTR and PACK than other ethnicities. As household income increased, consumers were more ($P < 0.05$) concerned about ANT and HORM. Heavy beef eaters (4 or more times/week) were less ($P < 0.05$) influenced by WEL, ANT, color, DIET, HORM, local, NATORG, and NUTR, but more ($P < 0.05$) influenced by USDA grade than light beef eaters (0-3 times/week). In general, as DOD preference increased from rare to well-done, importance of WEL, ANT, DIET, HORM, local, NATORG, and NUTR increased. Consumers who preferred flavor of beef viewed WEL, ANT, HORM, NATORG, NUTR, PACK, and price less ($P < 0.05$) concerning than consumers who prefer flavor of other meat proteins.

Conclusion: Gender, marital status, geographic location, household size, age, ethnic origin, annual household income, weekly beef consumption, DOD preference, and flavor preference affected many beef purchasing motivators of consumers. It is important to consider the demographics and preferences of consumers when marketing fresh beef steaks.

Keywords: beef, consumer, demographics, motivation, purchasing

Consumer Topics

11: TRENDS IN CONSUMER DEMOGRAPHICS AND WILLINGNESS TO PAY FOR PERCEIVED EATING QUALITY LEVELS OF LAMB

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Objectives: The relationships between the demographics of lamb consumers and their willingness-to-pay (WTP) for four eating quality (EQ) levels were analyzed for this study.

Materials and Methods: The study was conducted in five areas across the United States: Ohio (OH), Florida (FL), Texas (TX), Colorado (CO), and California (CA). A demographic questionnaire was distributed to consumers (n=1,440) during a lamb tasting session to acquire the following variables: gender (GEN), age, education (EDU), occupation (OCC), heritage (HER), income (INC), number of adults in household (NOA), number of children (NOC), consumption (CON), preferred degree of doneness (DOD). Additionally, the state in which the consumer participated was used as a factor that could affect WTP. At the conclusion of a tasting session, which consisted of 7 lamb samples representing various muscles, genders, breeds, weights, fatness levels, and pH levels, consumers were asked how much they would pay for each of the four quality levels [Unsatisfactory (UNS), Good, Better than everyday (BTE), and Premium (PREM)], using line scales anchored from \$0/lb. to \$40/lb. WTP of each EQ level was analyzed using the GLIMMIX procedure of SAS with each of the aforementioned demographic traits considered as fixed effects. Differences in LS means were determined ($\alpha=0.05$).

Results: Heritage and consumption affected ($P<0.05$) WTP at each EQ level. African Americans were willing to pay more than White and Native Americans for UNS, Good, and PREM EQ levels. Additionally, consumers who said they consumed lamb daily were willing to pay the least for all EQ levels. Furthermore, state impacted ($P<0.05$) WTP for BTE and PREM EQ levels, with OH and CO consumers willing to pay less than consumers from TX. Additionally, there was an influence of OCC on WTP ($P<0.05$) of UNS and Good EQ levels; consumers who worked in sales and service or as a laborer were willing to pay more than homemakers at both EQ levels. Income only had an influence ($P<0.05$) on WTP of PREM EQ, with consumers whose household income was \$50-75,000 USD paying the least. Preferred DOD impacted ($P<0.05$) WTP for all perceived quality levels except for BTE; consumers who preferred blue rare would pay the least for UNS and Good quality lamb, but would pay more per pound than consumers whose preferred DOD was rare for PREM quality lamb. Gender only influenced ($P<0.05$) WTP for UNS lamb with males willing to pay more than females. Moreover, age influenced ($P<0.05$) WTP; consumers under 20 would pay more for BTE quality lamb than people over the age of 40, and would pay more than people over the age 50 for PREM quality lamb. NOC influenced ($P<0.05$) WTP, with consumers who had more than 6 children willing to pay the least for UNS. Lastly, number of NOA and EDU had no impact ($P>0.05$) on consumer WTP, regardless of EQ level.

Conclusion: Based on these results, HER and CON had a significant impact on WTP for each EQ level, but NOA and EDU had no influence on WTP at any EQ level. Preferred DOD influenced the WTP of 3 out of 4 EQ levels. State where the test was conducted and increasing age only influenced the top two EQ levels, while OCC only had an impact only on the lower two EQ levels. Finally, gender and NOC played little role in WTP, as each trait only impacted WTP of UNS lamb. Likewise, income had little impact on WTP, although it did influence WTP of PREM quality lamb.

Keywords: consumer preference, lamb, willingness to pay

Consumer Topics

12: THE CONTRIBUTION OF TENDERNESS, JUICINESS, AND FLAVOR TO OVERALL CONSUMER BEEF EATING EXPERIENCE

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Objectives: To combine consumer palatability data from studies conducted within the past five years to evaluate the contribution of tenderness, juiciness, and flavor to overall consumer eating satisfaction.

Materials and Methods: Eleven consumer studies conducted within the last five years were used to determine a beef palatability model. Each study used the same 100 mm lines scales for consumer evaluation of steak tenderness, juiciness, flavor, and overall liking. Moreover, consumers rated each trait as either acceptable or unacceptable. Samples in all studies were cooked using similar dry-heat grilling procedures. Collectively, these studies resulted in more than 12,000 individual consumer observations. The raw data from all studies were compiled as a single dataset with the average sensory score for each palatability trait determined for each sample by averaging across the individual consumer ratings for the sample. The relative contribution of tenderness, juiciness, and flavor to consumer overall liking scores were determined by creating a multivariate regression model using sample means. The odds and relative risk of an unacceptable overall eating experience were determined based on the acceptability of the three individual sensory traits.

Results: The final beef palatability model determined was: Consumer overall liking = $(0.42 \times \text{tenderness}) + (0.07 \times \text{juiciness}) + (0.48 \times \text{flavor})$. The model accounted for more than 99% of the variation ($R^2 > 0.99$) in consumer overall liking scores and indicates flavor contributes the most (49.4%), followed by tenderness (43.4%), and juiciness (7.4%). The interaction terms among the traits were not significant ($P > 0.05$) and therefore were excluded from the model. The odds of overall palatability failing when tenderness was acceptable were 1 in 10 (10%) but increased to 2.2 to 1 (69%) when tenderness was unacceptable. When flavor was acceptable, only 1 in 15 (6.7% chance) steaks failed for overall palatability, but this increased to 3.3 to 1 (76% chance) when flavor was unacceptable. For juiciness, 1 in every 9 steaks (11% chance) failed for overall palatability when juiciness was acceptable, however this increased to close to 2 out of every 3 (66% chance) when juiciness was unacceptable. The odds ratios for overall palatability failure were 20.8, 17.1, and 49.0 for tenderness, juiciness, and flavor, respectively, with the risk of overall palatability failing 7.2, 6.5, and 12.3 times more likely if tenderness, juiciness or flavor, respectively failed. If multiple palatability traits failed, the odds of overall palatability failure increased to 86% to 96%. With respect to USDA quality grade of longissimus lumborum steaks, the odds of palatability failure increased ($P < 0.05$) as quality grade decreased from Prime (8.6% failure rate), to Average and High Choice (13.2% failure rate) to Low Choice (16.9% failure rate) to Select (25.3% failure rate) and Standard (28.0% failure rate).

Conclusion: These results indicate the relative contribution of tenderness, juiciness, and flavor to overall beef palatability. They indicate that the failure of even a single palatability trait dramatically increases the likelihood of overall palatability failure, indicating that no single palatability trait is most important, as beef palatability is dependent upon the acceptance of all three traits; tenderness, juiciness and flavor.

Keywords: beef, flavor, juiciness, Palatability, tenderness

Consumer Topics

13: EVALUATION OF LAMB CARCASS QUALITY CHARACTERISTICS IN RELATION TO CONSUMER SENSORY SCORES

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Objectives: Flank streakings and confirmation drive lamb quality grading, but in beef, quality is based on marbling in the ribeye. However, little to no research has been conducted linking flank streaking to lamb eating quality. The objective of this study was to determine the relationship between carcass fat indicator traits, intramuscular fat percentage (IMF), and the palatability traits of tenderness (TEN), juiciness (JUIC), flavor liking (FLAV) and overall liking (OALL), as rated by U.S. consumers

Materials and Methods: Carcasses (n=180; 60/treatment) were selected at a commercial lamb processor in Greeley, CO based on pork marbling standards (PMS) as low (PMS 1), intermediate (PMS 2) or high (PMS 3+), with marbling score and flank streaking (FS) being determined within seconds of carcass ribbing. Full lamb loins (IMPS 232; 1 × 1in) representing the 3 targeted marbling levels [LOW, Medium (MED,) HIGH] were obtained, vacuum packaged, shipped to Texas Tech University, and stored under refrigeration (2-4°C) until fabrication. On d 21 postmortem, loins were removed from packaging, and marbling (MB) was assessed following a 10-minute bloom period. Loins were fabricated, leaving only the Longissimus dorsi, then manually sliced into 2.5 cm thick chops, vacuum packaged, and either frozen immediately or stored at 2°C until 42 d postmortem, then frozen. Untrained consumers (n=360) from Lubbock, TX; Hicksville, OH; Clemson, SC; Logan, UT; and Stillwater, OK rated TEN, JUIC, FLAV and OALL on 100-mm line scales. Data for fat measures (FS, 21d MB, and IMF) were analyzed as complete randomized design using the GLIMMIX procedure of SAS 9.4 with fixed effects of target marbling level. Treatment LS means were separated with the PDIFF option of SAS ($\alpha=0.05$). Pearson correlation coefficients were determined using the CORR procedure of SAS.

Results: FS, MB, and IMF were all influenced ($P<0.01$) by target marbling level in a linear fashion. As expected, HIGH had the highest values (FS: Mt⁵⁴, MB: Md⁰⁹, and 6.2% IMF), MED were intermediate (FS: Sm⁷¹, MB: Sm⁵⁶, and 4.4% IMF), and LOW had the lowest values (FS: Sl⁵³, MB: Sl⁴¹, and 3.7% IMF). With flank streaking being commonly used to evaluate lamb quality, a strong positive correlation would be expected with marbling level and IMF. Within the eating quality traits, FLAV was most strongly correlated ($r=0.93$; $P<0.01$) to OALL, followed by JUIC ($r=0.63$) and tenderness ($r=0.62$). TEN and JUIC scores were also strongly related ($r=0.75$; $P<0.01$) to each other. There were strong relationships ($P<0.01$) between MB and IMF ($r=0.70$), as well as between FS with MB and IMF ($r=0.60, 0.44$, respectively). When examining the relationships between FS with the palatability traits, only JUIC had a correlation ($r=0.07$; $P<0.01$) with FS. MB was correlated ($P<0.01$) with TEN, JUIC, FLAV, and OALL, ($r=0.09, 0.13, 0.09$, and 0.09 , respectively). However, IMF was only related ($P<0.01$) to TEN ($r=0.08$) and JUIC ($r=0.09$).

Conclusion: Increasing MB, more so than FS, was positively linked to increasing eating quality scores. Fortunately, FS and MB were strongly associated; however, neither FS nor MB had strong linear correlations with lamb eating quality. Also, tenderness, juiciness and flavor liking are major drivers for consumer sensory scores for overall liking, with flavor liking having the biggest impact on overall liking of lamb.

Keywords: consumer, correlation, lamb, marbling

Consumer Topics

14: US CONSUMER ASSESSMENT OF LAMB LOIN AND LEG CHOPS FROM AUSTRALIA, NEW ZEALAND AND UNITED STATES

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Objectives: Although lamb is consumed in low volumes in the U.S., especially when compared to high lamb consumption countries such as Australia (AUS) and New Zealand (NZ), U.S. consumers have three main options when choosing lamb in the U.S.: domestic, imported from AUS, or imported from NZ. Based on previous research with beef, palatability differences in lamb are expected when comparing country origins and muscle types. The objective of this study was to evaluate the effects of country-of-origin and muscle type on palatability of lamb loin and leg chops as determined by U.S. consumers.

Materials and Methods: The U.S. lamb (n = 70 carcasses) was obtained from a commercial lamb processor in Colorado; full lamb loins (IMPS 232; 1 × 1) and paired lamb legs (IMPS 233A) were retained from those carcasses, vacuum packaged and shipped to Texas. Full lamb loins and lamb legs from AUS and NZ were procured from food distributors. Loins were fabricated to obtain only the *longissimus lumborum*, by removing tenderloins, bone, flank and all other secondary muscles. Legs were fabricated to obtain the *semimembranosus* with *adductor*. Loins and legs were trimmed of any visible external fat and connective tissue, manually fabricated into 2.5 cm thick chops, vacuum packaged, stored at 2°C, and frozen at 21d postmortem. Untrained consumers (n = 360) from Lubbock, TX; State College, PA; Gainesville, FL; Fort Collins, CO; and Fresno, CA rated tenderness, juiciness, flavor liking and overall liking on 100 mm line scales. Data for sensory attributes were analyzed as a 2 × 3 factorial design using the GLIMMIX procedure SAS (Version 9.4; SAS Inst. Inc., Cary, NC) with fixed effects of country, muscle and their interaction. Location and consumer within testing night were included as random effects. Treatment least squares means were separated with the PDIFF option of SAS at a significance level of $P < 0.05$.

Results: The interaction between country and muscle was detected for tenderness, flavor, and overall liking ($P < 0.05$). U.S. loins were more tender ($P < 0.05$) than all other treatments, followed by AUS and NZ loins, which did not differ ($P > 0.05$). Next, U.S. legs were more tender than legs from AUS or NZ, which did not differ ($P > 0.05$). Consumers preferred the flavor of U.S. loins more ($P < 0.05$) than all other treatments. Next, U.S. legs and AUS loins were similarly liked more than NZ loins, but consumers liked the flavor of legs from NZ and AUS less than any other treatment. Overall liking followed the exact same trend as flavor liking. Both country and muscle impacted ($P < 0.01$) juiciness scores. U.S. loin chops were juicier than AUS or NZ loin chops, regardless of muscle, and consumers rated loin chops juicier than legs chops, regardless of country ($P < 0.05$).

Conclusion: Consumers found palatability differences in lamb between country origins and muscle types. U.S. consumers prefer domestically sourced lamb over AUS and NZ when comparing tenderness, juiciness, flavor and overall liking. Loin chops were preferred over leg chops for all palatability traits. It is recommended that U.S. consumers purchase U.S. lamb and lamb loin for a better eating experience.

Keywords: Australia, consumer, lamb, New Zealand

Consumer Topics

15: CONSUMER EVALUATION OF NINE DIFFERENT BEEF CUTS FROM THREE USDA QUALITY GRADES

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Objectives: To determine consumer perceptions of nine cuts including strip steaks and eight Beef Innovation cuts of varying quality grades.

Materials and Methods: Beef strip loins (IMPS # 180), inside rounds (IMPS # 169) bottom rounds (IMPS # 171), shoulder clods (IMPS #114), and chuck rolls (IMPS # 116A) were selected from 3 USDA quality grades (Prime, Low Choice, Select; n = 10/quality grade). Sub-primals were vacuum packaged and aged 21d at 2 to 4°C. Sub-primals were fabricated into 2.54 cm steaks to represent eight Beef Innovation cuts (San Antonio, Western Griller, Delmonico, Flat Iron, Tucson, Denver, Ranch, and Shoulder Petite Tender steaks) as well as strip loin steaks. Steaks were cooked to 71°C on an electric clamshell grill (Cuisiart Griddler Deluxe, model GR-150, East Windsor, NJ) with temperatures monitored using thermocouples connected to a Doric Mini-trend Data logger 205 B-1-c OFT (Doric Scientific, San Diego, CA). Consumers (n = 210) were fed 9 samples representing differences in muscle and quality grade in a random order. Consumers evaluated steaks for juiciness, tenderness, flavor, and overall liking on continuous line scales. Additionally, consumers rated each trait either acceptable or unacceptable. Consumers also rated each sample as unsatisfactory, everyday, better than every day or premium quality. Data were analyzed as a 9 × 3 factorial with a model that included the fixed effects of cut, grade, and their interaction and the random effect of panel and steak peak temperature as a covariate.

Results: There were no muscle × quality grade interactions for all traits evaluated ($P > 0.05$). The Delmonico, Flat Iron, and Denver steaks were rated the highest ($P < 0.05$) for juiciness while strip loin steaks were rated similar ($P > 0.05$) to Ranch steaks. The Delmonico and Flat Iron were rated more tender ($P < 0.05$) than Denver steaks, which were more tender ($P < 0.05$) than all other cuts. The strip loin was rated similar ($P > 0.05$) in tenderness to the Shoulder Petite Tender and Ranch steak. The Western Griller was the toughest ($P < 0.05$) when compared to all other muscles, except the Tucson steak. The Delmonico and Flat Iron steaks were rated the highest for flavor ($P < 0.05$). The San Antonio, Western Griller and Tucson had the lowest ($P < 0.05$) overall liking ratings while the Delmonico had higher ($P < 0.05$) overall liking scores than all other cuts except for the Flat Iron. The Western Griller had the lowest percentage ($P < 0.05$) of steaks rated acceptable for tenderness. The Delmonico had the highest percentage ($P < 0.05$) of steaks rated acceptable for overall liking. The Delmonico had the highest percentage ($P < 0.05$) of steaks rated as premium quality whereas the San Antonio, Western Griller and Tucson had the highest percentage ($P < 0.05$) of steaks rated as unsatisfactory. For all muscles, Prime was rated the highest ($P < 0.05$) for all traits evaluated and had the highest percentage ($P < 0.05$) of steaks rated acceptable for juiciness, tenderness, flavor and overall liking.

Conclusion: The Delmonico, Flat Iron, and Denver steaks had a better eating quality than strip steaks. This represents an opportunity for retailers and foodservice to market these more affordable cuts and still deliver a high level of eating satisfaction to customers. Moreover, the positive impact of increased quality grade was consistent across all cuts.

Keywords: beef, consumer, Innovation Cuts, palatability, Quality grade

Consumer Topics

16: GRILLING TEMPERATURE EFFECTS ON TENDERNESS, JUICINESS, AND FLAVOR OF RIBEYE, TOP LOIN AND TOP SIRLOIN STEAKS

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Objectives: The objective of this study was to characterize the impact grilling temperature has on tenderness, juiciness and flavor of ribeye, top loin and top sirloin beef steaks.

Materials and Methods: Beef subprimals (n = 16 each; 48 total) were purchased from a local meat supplier. After aging 21 d post-processing, 2.54 cm thick steaks were hand cut and randomly assigned a grilling temperature treatment: 177°C, 205°C, or 232°C. Steaks were vacuum-packaged and frozen at -10°C until testing. Prior to testing, steaks were individually selected and thawed at 4°C 12-18 hours prior to analysis. Steaks were grilled to an internal temperature of 71°C on a commercial flat top grill set at 177°C, 205°C, or 232°C. Consumers (n = 80) were served nine samples representative of each treatment combination and prompted to rate their liking of overall, tenderness, juiciness, appearance, and flavor on a 9-point hedonic scale. The ends used to square off the sample were used to take color readings of the center of each cooked steak. Steaks selected for Warner-Bratzler Shear Force were held over night at 4°C before obtaining six 1.3 cm diameter cores from each steak. Samples from the steaks after cooking were quickly frozen in liquid nitrogen and stored at -80°C for GC/MS – Olfactory analysis. Results were analyzed as a 3x3 factorial random block design using analysis of variance. Date of consumer session and order were included as random effects in the consumer model. Weight of the sample was included as a covariate in the GC/MS model.

Results: No differences ($P > 0.05$) in consumer overall, tenderness, juiciness, appearance, and flavor liking were detected between steak type or grill temperature. The center color of ribeye steaks was redder (a^* ; $P < 0.05$) than top loin and top sirloin steaks. The ribeye steaks also had a greater ($P < 0.05$) hue angle than top sirloin steaks. Top loin steaks required 0.27 kg less peak shear force ($P < 0.05$) than ribeye and top sirloin steaks. Of the volatiles present during aroma analysis (n = 68), trimethyl-pyrazine (raw, musty, potato), 2-ethyl-5-methyl-pyrazine (coffee, nutty), 2-ethyl-6-methyl-pyrazine, 2,3-dimethyl pyrazine (meaty, musty, potato, cocoa), 3-butyl-2,5-dimethyl-pyrazine, and sulfur dioxide were greatest ($P < 0.05$) in total ion count when the grill surface was set to 177°C. 2,5-dimethyl pyrazine (a musty or potato aroma) was determined to have the greatest ($P < 0.05$) presence when the grill was set to 232°C and least at 177°C. 3-(methylthio)-propanal, known to have a cooked potato-like aroma, was least ($P < 0.05$) in ribeye steaks compared to top sirloin and strip loin steaks. Furthermore, 2,3-butanedione (buttery), 3-hydroxy-2-butanone (buttery, creamy), acetaldehyde (fresh, green), decanal (orange, citrus), dimethyl sulfide (asparagus, putrid), dodecanal (soapy, citrus), nonanal, sulfur dioxide, phenyl acetaldehyde (sweet, honey, rose), and thiobis-methane (sulfurous, tomato, creamy) were greatest ($P < 0.05$) for top sirloin cuts; whereas, 2,3-octanedione was greatest ($P < 0.05$) for ribeye steaks.

Conclusion: The tenderness and juiciness of beef steaks grilled at differing temperatures were not perceived to be different by consumers; however, grilling temperature impacts the time the steak is exposed to the grill and, thus, the volatile flavor aroma compounds of the final product.

Keywords: flavor, grill temperature, tenderness

Consumer Topics

17: CONSUMER SENSORY EVALUATION OF GRASS-FED, ANGUS, AND COMMODITY GROUND BEEF

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Objectives: Ground beef is one of the major sources of animal protein in the U.S., accounting for approximately 40% of beef consumption per capita. Several studies have looked at the flavor profile between grass-fed and grain-fed beef to identify if omega-3 fatty acids found in grass-fed ground beef play a key role in consumer flavor acceptability. Consumer sensory evaluation was conducted to evaluate consumer palatability ratings of grass-fed ground beef in comparison to Angus and commodity ground beef.

Materials and Methods: Grass-fed, Angus, and commodity 80/20 ground beef was obtained from local retail stores and a commercial meat processing facility. For each treatment 14 different production lots were used, and each lot contained 2.26 kg of ground beef. Ground beef patties were manually formed into 113 g patties using a template, crust frozen, vacuum packaged with 2 patties per package, and stored at -40°C for approximately 8 d. The remaining product was vacuum packaged and frozen at -40°C for consumer evaluation and moisture, fat, protein, and pH determination. Frozen ground beef patties were thawed for 24 h prior to consumer sensory analysis. Patties were cooked to 71°C initial internal temperature using a clamshell grill (Cuisinart, East Windsor, NJ) and held for approximately 5 min to allow a post-cook temperature rise to 74°C. Cooked ground beef patties were cut into 4 wedge-shaped pieces, and immediately served to panelists. A total of 98 consumers were recruited from Manhattan, KS. and adjacent areas and rated the samples using 100-point continuous line scales with anchors at both ends and the midpoint on electronic tablets. Patties were rated for tenderness, juiciness, flavor liking, texture liking, and overall liking, and each sample was rated as acceptable or unacceptable for each palatability trait.

Results: Moisture, fat, and protein content of commodity, grass-fed, and Angus ground beef used in this study were similar ($P>0.05$). Commodity ground beef had a pH that was higher ($P<0.05$) than Angus and grass-fed ground beef by 2.6% and 6.8%, respectively, which may have been contributed the result of lean finely textured beef as a component of this treatment. Consumers tended to rate grass-fed ground beef 4% and 6% lower ($P=0.06$) for flavor and texture liking, respectively than Angus and commodity ground beef. Angus and commodity ground beef were rated higher ($P<0.01$) for overall liking compared to grass-fed ground beef. Consumers found tenderness and juiciness similar ($P>0.05$) for all three types of ground beef. Overall, Angus ground beef was preferred ($P<0.05$) to grass-fed ground beef with an overall acceptability of 94.9% vs 82.5%, while commodity ground beef had a similar ($P>0.05$) overall acceptability to Angus and grass-fed ground beef. Consumers indicated no difference ($P>0.05$) for tenderness acceptability, juiciness acceptability, and texture acceptability among the three ground beef treatments. Commodity ground beef had the highest ($P<0.05$) flavor acceptability, while Angus and grass-fed ground beef had similar ($P>0.05$) acceptability percentages for flavor.

Conclusion: Consumers rated grass-fed, Angus, and commodity ground beef similar for all palatability traits, except overall liking, in which consumers preferred Angus and commodity over grass-fed ground beef.

Keywords: Consumer, ground beef, Palatability

Consumer Topics

18: CONSUMER TRIANGLE SENSORY TEST WITH THREE BEEF FAJITAS.

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Objectives: Beef fajitas are an extremely popular dish served in Mexican-themed restaurants in the US. Pre-marinated fajitas are also widely available as case-ready retail items. One fajita-producing company approached our research group about performing consumer discriminative testing to determine if two new proprietary fajita ingredient formulations differed from their current formulation. Therefore, the objective of this study was to determine if the current beef fajita formula differs from either of the two alternative beef fajita formulas.

Materials and Methods: Frozen vacuum packages of pre-processed/marinated fajitas (inside skirt steaks) were shipped to Texas Tech University. All processes/ingredient formulations are proprietary. Treatments included: treatment A beef fajita (**A**), treatment B beef fajita (**B**), and current beef fajita (**C**). Samples (whole muscle) were thawed overnight and cooked to a medium degree of doneness (71°C/160°F) monitored using a digital thermopen (Super-Fast Thermopen, ThermoWorks, American Fork, Utah). All samples were cooked on a clamshell grill (George Foreman) that was preheated to 375°F. After cooking, samples were sliced into ½” strips served warm to consumers (different sets of knives and cutting tables were used for each treatment). A triangle sensory test procedure was performed in a local supermarket in Lubbock (TX) using untrained consumers (n = 120).

Each consumer received two rounds representing each difference test (A vs. C or B vs. C), but the sampling order varied for each consumer. Round 1 was designed to determine if consumers could detect a difference between treatment A and the control (C) and round 2 was designed to determine if consumers could detect a difference between treatment B and the control (C). Consumers were instructed to taste samples from left to right. Two were the same, and they had to determine which was the odd sample. Consumers were also asked to complete a brief demographic questionnaire.

Sensory ballots were tallied for each treatment separately to determine the number of correct and incorrect responses. Using a statistical table (pg. 433 of Meilgaard et al., 2007), we determined if consumers were able to detect a difference between the new fajitas and the original formulation. The hypothesis of “no difference” was rejected if the number of correct responses was greater than or equal to the tabled value for a 120 observations ($\alpha=0.05$). The minimum number of correct responses required for significance was 50.

Results: Demographical information collected from the 120 consumers showed that a majority of participants eat beef either daily or weekly (24.2% and 64.2% respectively). Most participants were either Caucasian or Hispanic (59.2% and 26.7% respectively), which is very representative of the population in Lubbock, TX.

For the treatment A, 53 of 120 consumers correctly identified the sample that was different. For treatment B, 49 out of 120 consumers correctly identified the sample that was different. According to the statistical table for the critical number of correct responses in a triangle test, there was a difference ($P < 0.05$) between treatment A and C, but the consumers fail to distinguish difference between the treatment B and C.

Conclusion: According to the results, the consumers were unable to detect the difference between the current fajita formula and the treatment B.

Keywords: Beef fajita , Consumer, Triangle sensory test