

Beef Customer Satisfaction: Role of Cut, USDA Quality Grade, and City on In-Home Consumer Ratings¹

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ABSTRACT: An in-home beef study evaluated consumer ratings from moderate-to-heavy beef users as influenced by cut (top loin, top sirloin, and top round steaks), USDA quality grade (Top Choice, Low Choice, High Select, and Low Select), and city (Chicago, Houston, Philadelphia, and San Francisco). Consumers ($n = 2,212$) evaluated each steak for overall like (OLIKE), tenderness (TEND), juiciness (JUIC), flavor desirability (DFLAV), and flavor intensity (IFLAV) using 23-point hedonic scales (23 = like extremely, extremely tender, extremely juicy, like extremely, and an extreme amount of flavor; 1 = dislike extremely, not at all tender, not at all juicy, dislike extremely, and no flavor at all). A USDA grade \times cut interaction existed for OLIKE ($P < .05$). Consumers rated top loin steaks highest ($P < .05$) in OLIKE and ranked Top Choice highest of all steaks (P

$< .05$). Within the top loin, consumers were not ($P > .05$) able to distinguish OLIKE differences between Low Choice and High Select or between High Select and Low Select. For OLIKE, top sirloin was rated intermediate ($P < .05$) of the three cuts, and consumers were not able to detect ($P > .05$) USDA quality grade differences. For OLIKE, top round was the lowest-rated ($P < .05$) cut. However, consumers preferred (OLIKE, $P < .05$) Top Choice to the other USDA grades offered. Grade and city interacted to affect TEND, JUIC, DFLAV, and IFLAV. The cut \times city interaction was significant for all palatability attributes. Cut and city affected customer satisfaction more than USDA quality grade. Tenderness and flavor were important and equal contributors to OLIKE, $r = .85$ and $r = .86$, respectively.

Key Words: Beef, Market Research, Grading, Consumer Preferences

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Introduction

Customer satisfaction describes how well products and services meet or exceed a consumer's expectations. To date, the beef industry has conducted several

benchmark studies related to production (Lorenzen et al., 1993) and the retail meat counter (Morgan et al., 1991; Savell et al., 1991); however, no major recent nationwide study has evaluated how satisfied consumers are with beef palatability.

In this study, we investigated three factors associated with customer satisfaction ratings: USDA quality grade, city, and retail cut. The National Consumer Retail Beef Study (Savell et al., 1987) found a significant interaction between marbling and city. This interaction showed that marbling was more important in Philadelphia, where U.S. Choice beef was featured, than in San Francisco, where beef from lower grades was offered. Cities differ in the type of beef sold at retail markets in fat trim, composition (Savell et al., 1991), and tenderness (Morgan et al., 1991). Regional tastes and preferences create possible differences in types of beef that consumers would rate highest. Cities sampled in our previous research included Philadelphia, Houston, Kansas City, and San Francisco. Chicago was used in the present study to add a northern, midwestern U.S. Choice market, replacing Kansas City. In this investigation, two U.S.

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Choice markets and two U.S. Select markets were used.

Most research on consumer preference for beef has been conducted with longissimus (rib or loin steaks). Large-scale research projects dealing with customer satisfaction and involving different grades of beef should include additional cuts. Thus, top sirloin, top round, and top loin, were evaluated.

The Beef Customer Satisfaction Project was the largest in-home beef consumer study ever conducted in the United States. This study evaluated three kinds of beef steaks from four USDA grade levels in four major U.S. cities on consumer satisfaction of moderate-to-heavy beef users and was designed to provide information to develop appropriate marketing strategies for the beef industry based on the needs of consumers.

Materials and Methods

Beef Selection

Carcasses ($n = 600$) were selected from three packing facilities in Colorado, Texas, and Nebraska to represent the population attributes identified by results of the National Beef Quality Audit (Lorenzen et al., 1993). The three plants were selected to represent the primary regions of the country in which cattle are fed and slaughtered (AMI, 1993), realizing that some variation in consumer satisfaction may be associated with differences in processing practices at different facilities. Selection was limited to A maturity, Yield Grade 2 or 3 (USDA, 1989) carcasses weighing between 250 and 364 kg. Carcasses were graded (USDA, 1989) by a qualified USDA, Standardization Branch representative and were grouped into the following marbling classifications: Modest and Moderate marbling or Top Choice ($n = 150$); Small marbling or Low Choice ($n = 150$); upper 1/2 of Slight marbling (Slight 50 and higher) or High Select ($n = 150$); and lower 1/2 of Slight marbling (Slight 0 to 49) or Low Select ($n = 150$). Of the Top Choice marbling group, 2/3 of the carcasses selected were of Modest marbling, and 1/3 were Moderate marbling. The difference in marbling score between sides was no greater than 20% of a marbling score for each carcass with Slight and Small marbling. Both sides of the carcass were required to fit into the same quality level classification.

Each carcass was identified with a unique animal number that was transferred to each subprimal and every steak delivered to the homes of consumers. The strip loin (IMPS #180; NAMP, 1992; USDA, 1996), top sirloin (IMPS #184; NAMP, 1992; USDA, 1996), and top (inside) round (IMPS #168; NAMP, 1992; USDA, 1996) were obtained from both sides of each carcass, vacuum-packaged, boxed, and shipped by refrigerated truck to the Rosenthal Meat Science and Technology Center at Texas A&M University, College

Station for refrigerated storage at 2°C and further processing.

Steak Processing and Packaging

Following an aging period of 14 to 21 d, product packages were opened and mirror-image steaks were cut simultaneously from the right and left subprimals of each carcass. Top loin steaks (IMPS #1180B; NAMP, 1992; USDA, 1996) were cut 2.54 cm thick beginning at the anterior end; s.c. fat on each steak was trimmed not to exceed .32 cm; and top loin steak tails were cut to 1.27 cm. Top sirloin steaks (IMPS #1184B; NAMP, 1992; USDA, 1996) were cut 2.54 cm thick beginning at the posterior end, with the biceps femoris and all s.c. fat removed. Following removal of the adductor and all s.c. fat, the top round was cut into 1.59-cm-thick steaks (IMPS #1168; NAMP, 1992; USDA, 1996), beginning at the anterior end.

Eleven steaks were cut from each strip loin with eight steaks for consumers, two for Warner-Bratzler shear force (**WBS**) determination, and one for trained sensory panel evaluation. Six steaks were cut from each top sirloin and top round: four steaks for consumers, one for WBS, and one for sensory evaluation. Each steak from the top sirloin then was cut in half for a total of 12 portions, eight steaks for consumers, two for WBS, and two for trained sensory panel evaluation. Only those top round steaks designated for WBS determination were cut in half. The remaining consumer and sensory steaks were left intact for a total of seven steaks from each top round, four steaks for consumers (one per household to be shared by consumers within the household), two for WBS, and one for trained sensory panel evaluation. Sensory panel evaluation and WBS force determinations will be presented in another article.

Steaks were vacuum-packaged using an American National Can Bivac[®] machine with roll stock oxygen barrier film (American National Can, Neenah, WI) and blast-frozen at -40°C. After freezing, steaks were randomized by city; two steaks from each top loin and top sirloin and one steak from each top round went to every city. The remaining steaks were used for Warner-Bratzler shear force and trained sensory panel measurements. Steaks from each animal were assigned randomly to consumers within each city blocking by animal so that each consumer household would receive top loin, top sirloin, and top round steaks from the same animal within each quality grade level.

For each test week, sample packets, consisting of two steak kits, were prepared for each household. Each steak kit contained either two mirror-image steaks from top loins and top sirloins (a steak for each participant within a household), and a questionnaire for each steak, or one top round steak (to be shared by the two participants), and a questionnaire for each participant. Steak type was not repeated during any

one week. For the 6-wk trial, kits consisted of various combinations of the steak types and quality grades. Each steak kit was labeled appropriately with cut and meal number. Steaks then were placed in the appropriate weekly consumer packet, boxed by city and week, and shipped to each city by frozen food transport truck (-10°C). Boxes were stored at a central distribution site in commercial freezers until weekly deliveries were made. Sample packets were transported in commercial 45-L coolers with Dry Ice for weekly delivery to consumer households.

Consumer Recruitment

Consumer households in four cities, Houston, Chicago, Philadelphia, and San Francisco, were recruited by telephone. The study was conducted between the months of June and November 1993. The four cities chosen for use in this study were selected based on industry knowledge of quality grade predominantly sold in that region (National Live Stock and Meat Board, unpublished data). Two cities, Chicago and Philadelphia, that were considered to be "U.S. Choice" markets (those selling predominantly USDA Choice beef), and two cities, Houston and San Francisco, that were considered to be "U.S. Select" markets (those selling primarily USDA Select beef at the retail level) were chosen. Different markets were selected to accommodate consumer expectations or conditioned responses to quality grades generally sold in that region. Three hundred consumer households (two respondents per households) were recruited in each of the four cities. Only households that completed the study were used in the analysis (Chicago, $n = 269$; Philadelphia, $n = 275$; Houston, $n = 266$; and San Francisco, $n = 296$). The two respondents were classified as either the "primary preparer/shopper" or the "other participant."

To qualify as a participant in the study, a household had to have two adults between the ages of 21 and 64 yr of age with a specified minimum household income level of \$20,000. As part of the selection criteria, households also had to be moderate-to-heavy users of beef; more specifically, eat beef at least three times a week and prepare beef in the home at least two times per week. During the initial telephone screening process, the person who shopped for and(or) cooked for the family the majority of the time was identified as the primary preparer/shopper. This person was asked to complete a subsequent telephone interview to obtain demographic and attitudinal information (National Live Stock and Meat Board, 1995). This study was approved by the Institutional Human Use Committee at Texas A&M University, and informed consent was obtained from all participants.

In-Home Product Test

Sample packets containing two steaks for each respondent were delivered weekly for 6 wk (12 test

cells per respondent representing three cuts and four quality grade levels). The previous week's evaluation forms were collected during each delivery. Delivery personnel were trained in each city with a delivery dialogue and standard response format to maintain consistency of deliveries between the four cities. Steaks were identified for the participants by cut only, not by grade. Instructions for safe handling and storage of meat were provided; however, no instructions were given for beef preparation.

Respondents were asked to prepare the steaks as they would when buying the same cuts in the supermarket. Consumers evaluated each steak for overall like (**OLIKE**), tenderness (**TEND**), juiciness (**JUIC**), flavor desirability (**DFLAV**), and flavor intensity (**IFLAV**) using 23-point hedonic scales (23 = like extremely, extremely tender, extremely juicy, like extremely, and an extreme amount of flavor; 1 = dislike extremely, not at all tender, not at all juicy, dislike extremely, and no flavor at all). Sample means and standard deviations for OLIKE, TEND, JUIC, DFLAV, and IFLAV by cut, USDA quality grade, and city are presented in Table 1. Each evaluation form also included a question relative to the degree of doneness of the steaks at time of consumption. Each respondent completed separate evaluation forms and was instructed to complete the evaluation form immediately following the meal. Only consumer households completing the 6-wk trial were included in the study.

Data Analysis

The statistical model for consumer satisfaction ratings included main effects of cut, city, and USDA quality grade and their interactions. In addition, steak location nested within cut, week nested within city, animal nested within USDA quality grade, and packing facility were included in the model.

Statistical analyses were performed using SAS (1991). For all consumer data, Box-Cox transformations (Neter et al., 1989) were used to produce normally distributed errors. Least squares means were generated and tested for significance ($P < .05$) using Bonferroni's procedure (Lentner and Bishop, 1993). Dependent variables were tested for significance by ANOVA using the GLM procedure in SAS (1991). Only significant terms ($P < .05$) were retained in the model. Pairwise correlation coefficients were generated between consumer ratings to determine the relationship of the palatability attributes (tenderness, juiciness, and flavor) to consumers' overall like ratings.

Results

Consumer Overall Like Ratings

There were two significant main effect interactions for OLIKE: USDA quality grade \times cut ($P = .02$) and

Table 1. Consumer rating means (standard deviations) within cut, USDA quality grade, and city

| | Consumer ratings ^a | | | | |
|---------------------------|-------------------------------|---------------|---------------|---------------|---------------|
| | OLIKE | TEND | JUIC | DFLAV | IFLAV |
| Cut | | | | | |
| Top loin | 18.5 (3.9) | 18.5 (3.9) | 17.9 (4.3) | 18.6 (4.0) | 18.4 (4.0) |
| Top sirloin | 17.4 (4.3) | 17.1 (4.6) | 16.9 (4.7) | 17.7 (4.4) | 17.7 (4.2) |
| Top round | 16.0 (4.9) | 15.5 (5.4) | 15.0 (5.4) | 16.5 (4.9) | 16.5 (4.7) |
| USDA quality grade | | | | | |
| Top Choice | 17.6 (4.3) | 17.3 (4.6) | 16.9 (4.7) | 17.8 (4.3) | 17.8 (4.2) |
| Low Choice | 17.4 (4.4) | 17.1 (4.8) | 16.7 (4.9) | 17.7 (4.5) | 17.7 (4.3) |
| High Select | 17.1 (4.7) | 16.8 (5.0) | 16.4 (5.1) | 17.4 (4.7) | 17.4 (4.5) |
| Low Select | 17.2 (4.6) | 16.8 (5.0) | 16.3 (5.1) | 17.4 (4.5) | 17.4 (4.4) |
| City | | | | | |
| Chicago | 17.3 (4.7) | 17.1 (4.9) | 16.7 (5.0) | 17.6 (4.6) | 17.6 (4.5) |
| Houston | 18.2 (4.0) | 17.9 (4.3) | 17.4 (4.6) | 18.5 (3.9) | 18.4 (3.9) |
| Philadelphia | 16.9 (4.8) | 16.6 (5.1) | 16.3 (5.1) | 17.2 (4.7) | 17.2 (4.6) |
| San Francisco | 16.9 (4.5) | 16.6 (4.8) | 16.0 (4.9) | 17.1 (4.6) | 17.1 (4.4) |

^aOLIKE = overall like, TEND = tenderness, JUIC = juiciness, DFLAV = flavor desirability; and IFLAV = flavor intensity. Consumers used a 23-point hedonic scale where 23 = like extremely, extremely tender, extremely juicy, like extremely, and an extreme amount of flavor; 1 = dislike extremely, not at all tender, not at all juicy, dislike extremely, and no flavor at all.

cut × city ($P = .001$). For the USDA quality grade × cut interaction (Table 2), effects of grade on OLIKE were greatest among top loin steaks; Top Choice steaks were rated higher ($P < .05$) in OLIKE than the remainder of the grades. Ratings for High Select top loin steaks did not differ ($P > .05$) from those for Low Choice or Low Select steaks; however, OLIKE ratings for Low Choice differed from ratings for Low Select. Grade had no effect ($P > .05$) on OLIKE among the top sirloin steaks. Top Choice top round steaks were rated higher ($P < .05$) than the other grades of top

round steaks for OLIKE. Across all USDA quality grades, ratings for OLIKE for top loin steaks were higher ($P < .05$) than those for top sirloin steaks, and ratings for top sirloin steaks were higher ($P < .05$) than those for top round steaks.

Within each city, ratings for OLIKE for the top loin steaks were higher ($P < .05$) than those for top sirloin steaks, and those for top sirloin steaks were higher ($P < .05$) than those for top round steaks (Table 3). Comparisons among cities, within cut, show that consumers in Houston gave the highest ($P < .05$)

Table 2. Least squares means for cut × USDA quality grade effect on consumer overall like ratings (23 = like extremely; 1 = dislike extremely)

| Cut | USDA quality grade | | | |
|-------------|--------------------|-------------------|--------------------|-------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Top loin | 19.3 ^a | 19.1 ^b | 18.9 ^{bc} | 18.8 ^c |
| Top sirloin | 18.0 ^d | 18.1 ^d | 17.9 ^d | 18.0 ^d |
| Top round | 17.1 ^e | 16.9 ^f | 16.7 ^f | 16.7 ^f |

^{a,b,c,d,e,f}Means lacking a common superscript letter differ ($P < .05$).

Table 3. Least squares means for cut × city effect on consumer overall like ratings (23 = like extremely; 1 = dislike extremely)

| Cut | City | | | |
|-------------|-------------------|--------------------|--------------------|-------------------|
| | Chicago | Houston | Philadel- phia | San Francisco |
| Top loin | 19.1 ^b | 19.6 ^a | 19.0 ^b | 18.5 ^d |
| Top sirloin | 18.0 ^e | 18.8 ^c | 17.7 ^{fg} | 17.6 ^g |
| Top round | 17.1 ^h | 17.8 ^{ef} | 16.0 ^j | 16.5 ⁱ |

^{a,b,c,d,e,f,g,h,i,j}Means lacking a common superscript letter differ ($P < .05$).

OLIKE ratings for all three cuts. Consumers in San Francisco rated top loin steaks the lowest ($P < .05$) for OLIKE, whereas consumers in San Francisco and Philadelphia gave top sirloin steaks the lowest ($P < .05$) OLIKE ratings. Top round steaks received the lowest ($P < .05$) OLIKE ratings from consumers in Philadelphia. Consumers in Philadelphia seemed to be more discriminating than consumers in the other cities in that there was a 3-units difference between the top loin and top round steaks in Philadelphia and only a 2-units difference between those two cuts in the other three cities.

Consumer Tenderness Ratings

There were two significant main effect interactions for TEND: USDA quality grade \times city ($P = .03$) and cut \times city ($P = .001$). For the USDA quality grade \times city interaction (Table 4), consumers in Chicago and Philadelphia found Top Choice steaks to be more tender ($P < .05$) than steaks from the remaining USDA quality grades. However, consumers in Houston and San Francisco were unable to perceive tenderness differences between Top Choice and the other grades. As previously mentioned, Chicago and Philadelphia are considered to be "U.S. Choice" markets, and Houston and San Francisco are considered to be "U.S. Select" markets. It is not clear whether the inability of consumers in "U.S. Select" markets to differentiate higher marbling levels is based on preference or learned response.

For the city \times cut interaction (Table 5), consumers in Houston gave the highest TEND ratings for each cut ($P < .05$). Whereas TEND ratings for top loin steaks in Philadelphia were intermediate to those in Houston and San Francisco and similar to those in Chicago, Philadelphia consumers' TEND ratings for the top round steak were the lowest ($P < .05$) of any cut compared. Consumers in each city ranked the tenderness of the cuts identically to respondents in the National Beef Tenderness Survey (Morgan et al., 1991), with top loin most tender followed by top sirloin and top round.

Table 4. Least squares means for city \times USDA quality grade effect on consumer tenderness ratings (23 = extremely tender; 1 = not at all tender)

| City | USDA quality grade | | | |
|---------------|--------------------|--------------------|-------------------|--------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Chicago | 18.1 ^b | 17.9 ^c | 17.6 ^d | 17.8 ^{cd} |
| Houston | 18.5 ^{ab} | 18.6 ^a | 18.4 ^b | 18.3 ^b |
| Philadelphia | 17.7 ^{cd} | 17.3 ^e | 17.3 ^e | 17.1 ^e |
| San Francisco | 17.5 ^{de} | 17.4 ^{de} | 17.2 ^e | 17.1 ^e |

^{a,b,c,d,e}Means lacking a common superscript letter differ ($P < .05$).

Table 5. Least squares means for cut \times city effect on consumer tenderness ratings (23 = extremely tender; 1 = not at all tender)

| Cut | City | | | |
|-------------|-------------------|-------------------|-------------------|-------------------|
| | Chicago | Houston | Philadel-phia | San Francisco |
| Top loin | 19.0 ^b | 19.4 ^a | 18.9 ^b | 18.4 ^c |
| Top sirloin | 17.8 ^d | 18.5 ^c | 17.5 ^e | 17.3 ^e |
| Top round | 16.7 ^f | 17.3 ^e | 15.5 ^h | 16.1 ^g |

^{a,b,c,d,e,f,g,h}Means lacking a common superscript letter differ ($P < .05$).

Consumer Juiciness Ratings

There were two significant main effect interactions for JUIC: USDA quality grade \times city ($P = .02$) and cut \times city ($P = .001$). For the USDA quality grade \times city interaction (Table 6), ratings for Top Choice steaks were higher ($P < .05$) in Chicago and Philadelphia than were ratings for steaks for the remaining quality grades in those cities. In Houston and San Francisco, steaks from both Choice grades were rated higher ($P < .05$) than steaks from Low Select. Higher marbling levels were related to higher JUIC ratings for consumers in the four cities; however, the USDA quality grade threshold where the greatest differences occurred seemed to be related to the grade history of the specific city.

For the cut \times city interaction (Table 7), JUIC ratings were higher ($P < .05$) in each city for the top loin steaks, followed by top sirloin and top round steaks, respectively. Again, Houston consumers gave the highest JUIC ratings for steaks from each cut, and Philadelphia consumers were most critical of top round steaks compared to consumers in the other three cities. Of the four cities, San Francisco consumers gave the lowest JUIC ratings for top sirloin steaks. Ratings for JUIC followed the same trend as the other consumer attribute ratings that related palatability differences to differences between cuts (Morgan et al., 1991; Belk et al., 1993) and regional differences in consumers (Savell et al., 1987).

Table 6. Least squares means for cut \times USDA quality grade effect on consumer juiciness ratings (23 = extremely juicy; 1 = not at all juicy)

| City | USDA quality grade | | | |
|---------------|--------------------|---------------------|---------------------|---------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Chicago | 17.7 ^{ab} | 17.4 ^c | 17.2 ^{cd} | 17.3 ^c |
| Houston | 17.9 ^a | 18.0 ^a | 17.9 ^{ab} | 17.8 ^b |
| Philadelphia | 17.4 ^c | 16.8 ^{ef} | 16.8 ^{efg} | 16.6 ^{fgh} |
| San Francisco | 16.9 ^{de} | 16.7 ^{efg} | 16.6 ^{gh} | 16.4 ^h |

^{a,b,c,d,e,f,g,h}Means lacking a common superscript letter differ ($P < .05$).

Table 7. Least squares means for cut × city effect on consumer juiciness ratings (23 = extremely juicy; 1 = not at all juicy)

| Cut | City | | | |
|-------------|-------------------|-------------------|-------------------|-------------------|
| | Chicago | Houston | Philadel- phia | San Francisco |
| Top loin | 18.5 ^b | 18.8 ^a | 18.3 ^b | 17.7 ^d |
| Top sirloin | 17.5 ^e | 18.1 ^c | 17.3 ^e | 16.9 ^f |
| Top round | 16.1 ^g | 16.9 ^f | 15.0 ⁱ | 15.3 ^h |

a,b,c,d,e,f,g,h,i Means lacking a common superscript letter differ ($P < .05$).

Consumer Flavor Desirability and Consumer Beef Flavor Intensity Ratings

There were two significant main effect interactions for DFLAV: USDA quality grade × city ($P = .05$) and cut × city ($P < .001$). There were also two significant main effect interactions for IFLAV: USDA quality grade × city ($P = .02$) and cut × city ($P < .001$). For the USDA quality grade × city interactions (Tables 8 and 10), within each USDA quality grade, Houston consumers rated steaks higher ($P < .05$) for DFLAV and IFLAV than consumers from the other three cities. Consumers in Chicago and Philadelphia rated Top Choice steaks higher ($P < .05$) for DFLAV and IFLAV than both categories of Select steaks, but consumers in Houston and San Francisco were less sensitive to USDA quality grade.

For the cut × city interactions (Tables 9 and 11), within each cut, consumers in Houston gave the highest ($P < .05$) DFLAV and IFLAV ratings. Consumers in all cities rated cuts for DFLAV and IFLAV, from highest to lowest ($P < .05$), top loin, top sirloin, and top round, respectively.

Correlations of Consumer Attributes

Correlation coefficients among consumer palatability attributes showed a strong positive relationship between OLIKE ratings and all other attributes. Tenderness ($r = .85$), juiciness ($r = .77$), flavor

Table 8. Least squares means for city × USDA quality grade effect on consumer flavor desirability ratings (23 = an extreme amount; 1 = none at all)

| City | USDA quality grade | | | |
|---------------|--------------------|--------------------|-------------------|--------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Chicago | 18.7 ^c | 18.4 ^b | 18.2 ^e | 18.4 ^{de} |
| Houston | 19.0 ^{ab} | 19.2 ^a | 18.9 ^b | 18.9 ^b |
| Philadelphia | 18.3 ^{de} | 18.0 ^{ef} | 17.9 ^f | 17.8 ^f |
| San Francisco | 18.0 ^{ef} | 17.9 ^{ef} | 17.9 ^f | 17.7 ^f |

a,b,c,d,e,f Means lacking a common superscript letter differ ($P < .05$).

Table 9. Least squares means for cut × city effect on consumer flavor desirability ratings (23 = an extreme amount; 1 = none at all)

| Cut | City | | | |
|-------------|-------------------|-------------------|--------------------|-------------------|
| | Chicago | Houston | Philadel- phia | San Francisco |
| Top loin | 19.2 ^b | 19.7 ^a | 19.1 ^{bc} | 18.6 ^d |
| Top sirloin | 18.3 ^e | 19.0 ^c | 18.1 ^{ef} | 17.9 ^f |
| Top round | 17.5 ^g | 18.3 ^e | 16.8 ⁱ | 17.1 ^h |

a,b,c,d,e,f,g,h,i Means lacking a common superscript letter differ ($P < .05$).

desirability ($r = .86$), and beef flavor intensity ($r = .79$) were highly correlated to consumer overall like rating ($P < .001$).

These data support the relationship of tenderness, flavor, and juiciness to consumer perception of taste or palatability as found in the work of Parrish et al. (1991); however, the relationship differs somewhat from that found in the National Consumer Retail Beef Study (Savell et al., 1987, 1989), which found tenderness to be the single most important factor affecting consumer perceptions of beef. With similar correlation coefficients between overall like and flavor desirability and tenderness in this study, flavor may be as important as tenderness in determining consumer palatability.

Discussion

Cut

For all palatability characteristics, top loin steaks were rated higher than top sirloin steaks, and top sirloin steaks were rated higher than top round steaks. Steak palatability attributes are influenced by a variety of factors; differences in background connective tissue levels (Harris et al., 1992), sarcomere length (Herring et al., 1968), and the amount of chemical fat in the lean (Jones et al., 1992) may play the greatest roles in determining the inherent palatability differences among these cuts.

Table 10. Least squares means for city × USDA quality grade effect on consumer beef flavor intensity ratings (23 = extremely intense; 1 = no flavor)

| City | USDA quality grade | | | |
|---------------|--------------------|--------------------|--------------------|-------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Chicago | 18.6 ^c | 18.4 ^d | 18.1 ^{de} | 18.3 ^d |
| Houston | 19.0 ^{ab} | 19.2 ^a | 19.0 ^{ab} | 18.8 ^b |
| Philadelphia | 18.3 ^d | 18.0 ^{ef} | 18.0 ^e | 17.8 ^f |
| San Francisco | 18.0 ^e | 18.0 ^{ef} | 17.8 ^{ef} | 17.7 ^f |

a,b,c,d,e,f Means lacking a common superscript letter differ ($P < .05$).

Table 11. Least squares means for cut \times city effect on consumer beef flavor intensity ratings (23 = extremely intense; 1 = no flavor)

| Cut | City | | | |
|-------------|-------------------|--------------------|-------------------|-------------------|
| | Chicago | Houston | Philadel- phia | San Francisco |
| Top loin | 19.1 ^b | 19.6 ^a | 18.9 ^c | 18.5 ^d |
| Top sirloin | 18.4 ^d | 19.1 ^{bc} | 18.2 ^d | 18.0 ^e |
| Top round | 17.5 ^f | 18.3 ^d | 16.8 ^g | 17.0 ^g |

^{a,b,c,d,e,f,g}Means lacking a common superscript letter differ ($P < .05$).

USDA Quality Grade

For OLIKE ratings, effect of USDA quality grade was cut-specific. The cut most affected was the top loin steak, and this agrees with the findings of Smith et al. (1987). The USDA quality grade did not affect consumer ratings for top sirloin steak and only was of consequence for top round steak when the highest evaluated category, Top Choice, was compared with the remaining grades.

The USDA quality grade has been a controversial topic for many decades. Some believe strongly that grades perform well in sorting and categorizing beef for the marketplace. Others believe that the relationship between marbling and palatability is too low to serve as any real basis for identification of products for consumers. Findings from this study and that of Smith et al. (1987) suggest that USDA quality grade may be limited in the sorting of products for the marketplace derived from the longissimus muscle, and that it has less effect on the remaining major muscles of the beef carcass.

City

For every palatability attribute evaluated, city was involved in interactions with either cut or USDA quality grade. The most common finding dealt with the way consumers in the traditionally "U.S. Choice" markets could favorably distinguish Top Choice steaks. However, consumers in traditionally "U.S. Select" markets were not always able to distinguish between quality grades. This presents some interesting opportunities and problems for the retail marketing of beef.

Implications

Customer satisfaction for beef steaks is a complex issue because of the interrelated effects of cut, USDA quality grade, and city on palatability. From a marketing standpoint, this creates problems in determining which qualities of which cuts go to which cities

to maximize customer satisfaction. Targeted marketing of beef to consumers using a well-defined plan may be the logical system needed to ensure maximum eating enjoyment.

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