

# Beef Customer Satisfaction: Factors affecting consumer evaluations of clod steaks<sup>1</sup>

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**ABSTRACT:** An in-home beef study evaluated consumer ratings of clod steaks ( $n = 1,264$ ) as influenced by USDA quality grade (Top Choice, Low Choice, High Select, and Low Select), city (Chicago and Philadelphia), consumer segment (Beef Loyals, who are heavy consumers of beef; Budget Rotators, who are cost-driven and split meat consumption between beef and chicken; and Variety Rotators, who have higher incomes and education and split their meat consumption among beef, poultry, and other foods), degree of doneness, and cooking method. Consumers evaluated each steak for Overall Like, Tenderness, Juiciness, Flavor Like, and Flavor Amount using 10-point scales. Grilling was the predominant cooking method used, and steaks were cooked to medium-well and greater degrees of doneness. Interactions existed involving the consumer-controlled factors of degree of doneness and(or) cooking method for all consumer-evaluated traits for the clod steak ( $P < 0.05$ ). USDA grade did not affect any consumer evaluation traits or Warner-Bratzler shear force values ( $P > 0.05$ ). One significant main effect, segment ( $P = 0.006$ ), and one significant interaction, cooking method  $\times$  city ( $P = 0.0407$ ), existed for Overall Like ratings. Consumers in

the Beef Loyals segment rated clod steaks higher in Overall Like than the other segments. Consumers in Chicago tended to give more uniform Overall Like ratings to clod steaks cooked by various methods; however, consumers in Philadelphia gave among the highest ratings to clod steaks that were fried and among the lowest to those that were grilled. Additionally, although clod steaks that were fried were given generally high ratings by consumers in Philadelphia, consumers in Chicago rated clod steaks cooked in this manner significantly lower than those in Philadelphia. Conversely, consumers in Chicago rated clod steaks that were grilled significantly higher than consumers in Philadelphia. Correlation and stepwise regression analyses indicated that Flavor Like was driving customer satisfaction of the clod steak. Flavor Like was the sensory trait most highly correlated to Overall Like, followed by Tenderness, Flavor Amount, and Juiciness. Flavor Like was the first variable to enter into the stepwise regression equation for predicting Overall Like, followed by Tenderness and Flavor Amount. For the clod steak, it is likely that preparation techniques that improve flavor without reducing tenderness positively affect customer satisfaction.

Key Words: Beef, Consumer Preference, Market Research, Meat Grades

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## Introduction

The beef industry has conducted several studies related to production (Lorenzen et al., 1993; Boleman et al., 1998) and the retail case (Morgan et al., 1991; Savell et al., 1991), but less is known about consumer preferences. The National Consumer Retail Beef Study (Savell et al., 1987, 1989) was the beginning of industry efforts to gather detailed information on consumer practices. In 1995, a comprehensive in-home product test among frequent beef consumers titled “Beef Customer

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Satisfaction” was reported (National Live Stock and Meat Board, 1995). The study, through this report and a series of articles, provided excellent insight into the relationship of beef quality and customer satisfaction. Examining the role of cut (top loin, top sirloin, and top round steaks), USDA quality grade (Top Choice, Low Choice, High Select, and Low Select), and city (Chicago, Philadelphia, Houston, and San Francisco) on consumer ratings, Neely et al. (1998) reported interactions among these factors for all palatability attributes. When included in the analyses, the consumer-controlled factors of degree of doneness and cooking method also were shown to have a great impact on customer satisfaction with the three cuts (Lorenzen et al., 1999; Neely et al., 1999; Savell et al., 1999).

As is often the case, the Beef Customer Satisfaction Study created as many questions as it answered. The relationship of quality to customer satisfaction, as found in the higher-valued top loin steak (Neely et al., 1998; Lorenzen et al., 1999) and in the lower-valued top round steak (Neely et al., 1998, 1999), may exist for other lower-valued and underused cuts such as the clod steak. As an extension of the Beef Customer Satisfaction Study, the objective of this research was to examine the role of USDA quality grade level, city, and consumer segment in combination with degree of doneness and cooking method on customer satisfaction with clod steaks.

## Materials and Methods

### *Beef Selection*

Carcasses ( $n = 300$ ) were selected from the Excel Corporation (Schuyler, NE) beef processing facility. Selection was limited to A maturity, Yield Grade 2 or 3 (USDA, 1997) carcasses weighing between 250 and 374 kg. Dark cutters, bullocks, and carcasses displaying blood splash were not eligible for selection. Carcasses were graded by a USDA, Standardization Branch representative and were selected to equally represent the following quality groups: Top Choice (Modest to Moderate marbling); Low Choice (Small marbling); High Select (upper half of Slight marbling); and Low Select (lower half of Slight marbling). Each carcass was identified with a unique animal number that was transferred to each subprimal and its subsequent steaks. The clod (IMPS #114; NAMP, 1997; USDA, 1996) was obtained from both sides of each carcass, vacuum-packaged, boxed, and shipped to 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, mirror-image steaks were removed simultaneously from the right and left subprimals of each carcass using two band-saws.

Clod steaks (IMPS #1114E; NAMP, 1997; USDA, 1996) were cut 2.54 cm thick, with the tensor fasciae anti-brachii muscle removed. Five steaks were removed from each subprimal and identified individually. The first steak, beginning at the anterior end of the clod, was assigned for Warner-Bratzler shear force determination. The remaining steaks, used for consumer evaluation, were paired with their mirrored steaks from the clod of the opposing side of the same carcass. All steaks were trimmed free of s.c. fat. Steaks were vacuum-packaged individually on an American National Can Bivac machine using roll-stock oxygen barrier film (American National Can, Chicago, IL) and blast-frozen at -40°C. Steaks remained frozen through delivery to the consumers.

### *Steak Distribution*

Paired clod steaks were supplied to the same household. Each participant was provided a clod steak from Top Choice, Low Choice, High Select, and Low Select carcasses. Sample packets prepared for each household (two participants per household) included steaks assigned to each household and their accompanying customer satisfaction evaluation questionnaires. Each steak was labeled with the household number and the order in which the steak was to be consumed. An identical label was placed on a questionnaire so that each steak had a corresponding questionnaire. Order of the presentation of the cuts to the households was randomized to reduce response-order effects on the consumer ratings. Sample packets were boxed by city and shipped by frozen-food transport truck (-10°C). Boxes were stored in commercial freezers until the sample packets were delivered to the households.

At the first delivery point, each household received two of the four meals (a meal consisted of two steaks, one for each of the participants in the household). During the second delivery point, approximately 2 wk later, each household was given the remaining two meals and the questionnaires from the first delivery point were retrieved. A third home visit was made approximately 2 wk later to retrieve the questionnaires from the final two meals. Consumers were not given any information about the steaks other than the name of the cut and the order in which the steaks were to be consumed.

### *Consumer Recruitment*

Consumers in Chicago and Philadelphia were recruited by telephone. To qualify for inclusion in the study, households had to consist of two adults over 21 yr of age and have a minimum household income of \$20,000. Additionally, the participants had to be at least moderate beef users, consuming beef at the main meal at least twice a week. After agreeing to participate in the study, the primary food shopper and preparer in the household were asked to complete a pretest interview. This interview included demographic and basic

lifestyle and attitude information about food and cooking.

Wirthlin Worldwide (Chicago, IL) analyzed this information and, using an in-house cluster analysis algorithm, assigned households to one of three segments to determine the impact of these attitudes on consumer satisfaction of beef: Beef Loyals, Budget Rotators, and Variety Rotators. Beef Loyals were defined as heavy beef eaters, eating all kinds of beef. They were average in age, income, education, and household size. They were not particularly concerned with diet and health issues. Their food preferences were not driven by budget concerns. They had positive attitudes about beef and considerably fewer positive attitudes about chicken.

Budget Rotators split meat consumption among beef and chicken. Having larger households and less education compared to the other segments, they were somewhat more focused on budget concerns. Their attitudes toward chicken were somewhat more positive than attitudes toward beef.

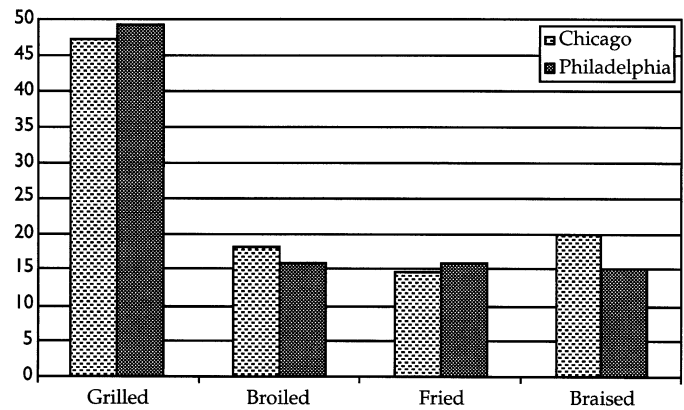
Variety Rotators were characterized as heavy meat eaters, but they split their meat consumption among beef, poultry, and other foods. They were somewhat older and had higher incomes and education levels than the other segments. Their perceptions of beef and chicken were, in general, equally positive.

#### Customer Satisfaction Evaluation

Guidelines for safe handling and storage of meat were provided to all participants. Respondents were asked to prepare the steaks as they would when buying the same cuts in the supermarket. Consumers evaluated each steak for overall satisfaction, tenderness, juiciness, flavor desirability (flavor like), and flavor intensity (flavor amount) using a 10-point scale (10 = 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 none at all). Each evaluation form also asked participants to determine degree of doneness of the beef at the time of consumption as measured on the National Live Stock and Meat Board beef steak color chart. Participants responded to this question by making one of the following choices: very rare, rare, medium-rare, medium, medium-well, well done, or very well done. Meal preparers also were asked to indicate cooking method. These methods, as described by the National Live Stock and Meat Board (1992), included outdoor-grilled, indoor-grilled, broiled, oven-roasted, pan-broiled, pan-fried/sautéed, stir-fried, deep-fried, braised, poached, simmered and stewed, and "other." Respondents were instructed to complete the evaluation forms immediately following the meal. Only consumer households completing the entire study were included in the analyses.

#### Warner-Bratzler Shear Force Determination

Steaks designated for Warner-Bratzler shear force determination remained frozen until analyses could be



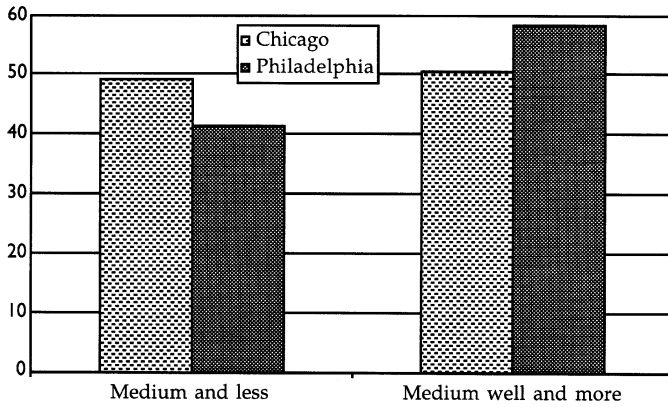
**Figure 1.** Cooking method frequency distributions for clod steaks stratified by city. Grilling included outdoor grilling and indoor grilling; Broiling included broiling, oven roasting, and pan-broiling; frying included pan-frying/sautéing and stir-frying; braising included braising, poaching, and simmering and stewing.

performed. Steaks were thawed at refrigerated (2°C) temperature and cooked on Farberware Open Hearth electric broilers (Kidde, Bronx, NY) to a medium (70°C) degree of doneness. Internal temperature was monitored with a copper constantan thermocouple inserted into the geometric center of each steak, and temperatures were recorded on an Omega hand-held microcomputer thermometer model HH-72T (Omega Engineering, Stamford, CT).

Steaks were cooled to room temperature for 4 to 6 h before six 1.3-cm-diameter cores were removed parallel to the muscle fibers of each steak. Cores were sheared perpendicular to the muscle fibers using a Warner-Bratzler shear force device (Chatillon and Sons, New York, NY). The shear force (kg) for each steak was reported as the mean of the six cores.

#### Data Analysis

Statistical analyses were performed using SAS (SAS Inst. Inc., Cary, NC). Using the PROC GLM procedure, the statistical model for customer satisfaction ratings for clod steaks included the main effects of grade, city, segment, degree of doneness, cooking method, and their two-way interactions. Only significant terms ( $P < 0.05$ ) were retained in the model. Least squares means were generated and separated using the p-diff option. Pairwise correlation coefficients (PROC CORR) were generated between consumer ratings to determine the relationship of palatability attributes (tenderness, juiciness, and flavor) to Overall Like ratings. The PROC REG stepwise regression analysis was performed to develop equations involving those sensory traits that most contributed to Overall Like ratings. Frequency distributions for cooking method and degree of doneness within city were generated using PROC FREQ.



**Figure 2.** Degree of doneness frequency distributions for clod steaks stratified by city.

## Results

Frequency distributions of cooking method and degree of doneness by city are presented in Figures 1 and 2. Some cooking methods and degrees of doneness were infrequently used and were combined for analysis. For cooking method, outdoor-grilled and indoor-grilled were combined into “grilled”; broiled, oven-roasted, and pan-broiled were classified as “broiled”; pan-fried/sautéed and stir-fried were combined into “fried”; braised, poached, and simmered and stewed were grouped as “braised.” For degree of doneness, two categories were created: “medium and less” (medium, medium-rare, rare, and very rare) and “medium well and more” (medium-well, well done, and very well done).

The predominant method of cooking used by consumers to prepare clod steaks was grilling (Figure 1). Frying was used by consumers in Philadelphia more than by those in Chicago, whereas consumers in Chicago tended to use broiling and braising more often than consumers in Philadelphia. For degree of doneness, consumers in Philadelphia tended to cook clod steaks more well-done (Figure 2).

### Consumer Overall Like Ratings

One main effect, segment ( $P = 0.006$ ), and one interaction, cooking method  $\times$  city ( $P = 0.0407$ ), were found to be significant sources of variation for Overall Like ratings. Consumers in the Beef Loyals segment rated clod steaks higher in Overall Like than did those in the other segments (Table 1). For the cooking method  $\times$  city

**Table 1.** Least squares means for segment effect on clod steak Overall Like ratings (10 = like extremely; 1 = dislike extremely)

Beef Loyals	Budget Rotators	Variety Rotators
6.90 <sup>a</sup>	6.47 <sup>b</sup>	6.45 <sup>b</sup>

<sup>a,b</sup>Least squares means for consumer ratings without a common superscript letter differ ( $P < 0.05$ ).

**Table 2.** Least squares means for cooking method  $\times$  city effect on clod steak Overall Like ratings (10 = like extremely; 1 = dislike extremely)

Cooking method	City	
	Chicago	Philadelphia
Grilled <sup>a</sup>	6.62 <sup>ef</sup>	6.27 <sup>g</sup>
Broiled <sup>b</sup>	6.71 <sup>efg</sup>	6.49 <sup>efg</sup>
Fried <sup>c</sup>	6.31 <sup>fg</sup>	6.92 <sup>e</sup>
Braised <sup>d</sup>	6.77 <sup>efg</sup>	6.77 <sup>efg</sup>

<sup>a</sup>Grilled included outdoor-grilled and indoor-grilled.

<sup>b</sup>Broiled included broiled, oven-roasted, and pan-broiled.

<sup>c</sup>Fried included pan-fried/sautéed and stir-fried.

<sup>d</sup>Braised included braised, poached, and simmered and stewed.

<sup>e,f,g</sup>Least squares means for consumer ratings without a common superscript letter differ ( $P < 0.05$ ).

interaction (Table 2), consumers in Chicago tended to give more uniform and less differentiated Overall Like ratings to clod steaks cooked by various methods; however, consumers in Philadelphia gave among the highest ratings to clod steaks that were fried and among the lowest to those that were grilled. Additionally, whereas clod steaks that were fried were given generally high ratings by consumers in Philadelphia, consumers in Chicago rated clod steaks cooked in this manner significantly lower than those in Philadelphia. Conversely, consumers in Chicago rated clod steaks that were grilled significantly higher than consumers in Philadelphia.

### Consumer Tenderness Ratings

Two significant interactions existed for clod steaks for Tenderness ratings: cooking method  $\times$  city ( $P = 0.0247$ ) and cooking method  $\times$  degree of doneness ( $P = 0.0081$ ). For the cooking method  $\times$  city interaction (Table 3), clod steaks that were braised received among the highest Tenderness ratings in both cities. Among the cooking methods, clod steaks that were fried received among the lowest Tenderness ratings in Chicago, whereas clod steaks prepared similarly received among

**Table 3.** Least squares means for cooking method  $\times$  city effect on clod steak Tenderness ratings (10 = very tender; 1 = not at all tender)

Cooking method	City	
	Chicago	Philadelphia
Grilled <sup>a</sup>	6.33 <sup>g</sup>	6.15 <sup>g</sup>
Broiled <sup>b</sup>	6.40 <sup>fg</sup>	6.41 <sup>fg</sup>
Fried <sup>c</sup>	5.96 <sup>g</sup>	6.86 <sup>fg</sup>
Braised <sup>d</sup>	6.93 <sup>ef</sup>	7.11 <sup>e</sup>

<sup>a</sup>Grilled included outdoor-grilled and indoor-grilled.

<sup>b</sup>Broiled included broiled, oven-roasted, and pan-broiled.

<sup>c</sup>Fried included pan-fried/sautéed and stir-fried.

<sup>d</sup>Braised included braised, poached, and simmered and stewed.

<sup>e,f,g</sup>Least squares means for consumer ratings without a common superscript letter differ ( $P < 0.05$ ).

**Table 4.** Least squares means for cooking method × degree of doneness effect on clod steak Tenderness ratings (10 = very tender; 1 = not at all tender)

Cooking method	Degree of doneness	
	Medium and less	Medium-well and more
Grilled <sup>a</sup>	6.43 <sup>f</sup>	6.04 <sup>gh</sup>
Broiled <sup>b</sup>	6.78 <sup>ef</sup>	6.03 <sup>gh</sup>
Fried <sup>c</sup>	6.18 <sup>fgh</sup>	6.64 <sup>f</sup>
Braised <sup>d</sup>	6.76 <sup>efg</sup>	7.28 <sup>e</sup>

<sup>a</sup>Grilled included outdoor-grilled and indoor-grilled.  
<sup>b</sup>Broiled included broiled, oven-roasted, and pan-broiled.  
<sup>c</sup>Fried included pan-fried/sautéed and stir-fried.  
<sup>d</sup>Braised included braised, poached, and simmered and stewed.  
<sup>e,f,g,h</sup>Least squares means for consumer ratings without a common superscript letter differ ( $P < 0.05$ ).

the highest Tenderness ratings in Philadelphia. This trend was similar to the cooking method × city interaction for Overall Like ratings of clod steaks.

The only clear difference between the two categories of degree of doneness within cooking method was for grilled and broiled; clod steaks cooked medium and less were rated higher for Tenderness than those cooked medium-well or more (Table 4). Greater differences in Tenderness ratings were found among cooking methods within the medium-well and more category than within the medium and less category.

*Consumer Juiciness Ratings*

Degree of doneness had a significant ( $P = 0.0001$ ) effect on Juiciness, as did the interaction of cooking method × city ( $P = 0.0037$ ). As would be expected, clod steaks cooked to medium and less were rated higher in Juiciness than those cooked to medium-well and more (Table 5). For the cooking method × city interaction (Table 6), it was found that in Chicago, consumers who braised clod steaks gave the highest Juiciness ratings compared to the other cooking methods. In Philadelphia, consumers who braised or fried clod steaks gave the highest Juiciness ratings compared to the other cooking methods. Clod steaks cooked with dry heat (grilled and broiled) generally received among the lowest Juiciness ratings.

*Consumer Flavor Like Ratings*

There was one significant main effect for Flavor Like, segment ( $P = 0.0307$ ), and the only significant interac-

**Table 5.** Least squares means for degree of doneness effect on clod steak Juiciness ratings (10 = very juicy; 1 = not at all juicy)

Medium and less	Medium-well and more
6.82 <sup>a</sup>	5.86 <sup>b</sup>

<sup>a,b</sup>Least squares means for consumer ratings without a common superscript letter differ ( $P < 0.05$ ).

**Table 6.** Least squares means for cooking method × city effect on clod steak Juiciness ratings (10 = very juicy; 1 = not at all juicy)

Cooking method	City	
	Chicago	Philadelphia
Grilled <sup>a</sup>	6.09 <sup>f</sup>	5.99 <sup>f</sup>
Broiled <sup>b</sup>	6.05 <sup>f</sup>	6.06 <sup>f</sup>
Fried <sup>c</sup>	5.84 <sup>f</sup>	6.97 <sup>e</sup>
Braised <sup>d</sup>	6.89 <sup>e</sup>	6.83 <sup>e</sup>

<sup>a</sup>Grilled included outdoor-grilled and indoor-grilled.  
<sup>b</sup>Broiled included broiled, oven-roasted, and pan-broiled.  
<sup>c</sup>Fried included pan-fried/sautéed and stir-fried.  
<sup>d</sup>Braised included braised, poached, and simmered and stewed.  
<sup>e,f</sup>Least squares means for consumer ratings without a common superscript letter differ ( $P < 0.05$ ).

**Table 7.** Least squares means for segment effect on clod steak Flavor Like ratings (10 = like extremely; 1 = dislike extremely)

Beef Loyals	Budget Rotators	Variety Rotators
6.86 <sup>a</sup>	6.54 <sup>ab</sup>	6.49 <sup>b</sup>

<sup>a,b</sup>Least squares means for consumer ratings without a common superscript letter differ ( $P < 0.05$ ).

tion found for Flavor Like was cooking method × degree of doneness ( $P = 0.0447$ ). Beef Loyals gave among the highest Flavor Like ratings, whereas Variety Rotators gave among the lowest Flavor Like ratings (Table 7). Cooking method × degree of doneness effects are given in Table 8. When cooked to medium and less, clod steaks that were broiled received significantly higher ratings than those cooked to a higher degree of doneness.

*Consumer Flavor Amount Ratings*

For Flavor Amount, a cooking method × city interaction was found to be significant ( $P = 0.0307$ ). Greater differences in Flavor Amount ratings occurred among the different cooking methods in Philadelphia than in

**Table 8.** Least squares means for cooking method × degree of doneness effect on clod steak Flavor Like ratings (10 = like extremely; 1 = dislike extremely)

Cooking method	Degree of doneness	
	Medium and less	Medium-well and more
Grilled <sup>a</sup>	6.58 <sup>efg</sup>	6.23 <sup>f</sup>
Broiled <sup>b</sup>	7.00 <sup>e</sup>	6.17 <sup>fg</sup>
Fried <sup>c</sup>	6.64 <sup>ef</sup>	6.98 <sup>e</sup>
Braised <sup>d</sup>	6.74 <sup>ef</sup>	6.71 <sup>e</sup>

<sup>a</sup>Grilled included outdoor-grilled and indoor-grilled.  
<sup>b</sup>Broiled included broiled, oven-roasted, and pan-broiled.  
<sup>c</sup>Fried included pan-fried/sautéed and stir-fried.  
<sup>d</sup>Braised included braised, poached, and simmered and stewed.  
<sup>e,f,g</sup>Least squares means for consumer ratings without a common superscript letter differ ( $P < 0.05$ ).

**Table 9.** Least squares means for cooking method × city effect on clod steak Flavor Amount ratings (10 = an extreme amount; 1 = none at all)

Cooking method	City	
	Chicago	Philadelphia
Grilled <sup>a</sup>	6.56 <sup>fg</sup>	6.27 <sup>g</sup>
Broiled <sup>b</sup>	6.59 <sup>efg</sup>	6.40 <sup>fg</sup>
Fried <sup>c</sup>	6.39 <sup>fg</sup>	7.04 <sup>e</sup>
Braise <sup>d</sup>	6.76 <sup>ef</sup>	6.46 <sup>fg</sup>

<sup>a</sup>Grilled included outdoor-grilled and indoor-grilled.

<sup>b</sup>Broiled included broiled, oven-roasted, and pan-broiled.

<sup>c</sup>Fried included pan-fried/sautéed and stir-fried.

<sup>d</sup>Braised included braised, poached, and simmered and stewed.

<sup>e,f,g</sup>Least squares means for consumer ratings without a common superscript letter differ ( $P < 0.05$ ).

**Table 10.** Simple correlations of consumer ratings for clod steaks<sup>a</sup>

Rating	Overall Like	Tenderness	Juiciness	Flavor Like
Tenderness	0.80			
Juiciness	0.73	0.78		
Flavor Like	0.86	0.79	0.78	
Flavor Amount	0.78	0.71	0.72	0.87

<sup>a</sup>All correlations are  $P < 0.0001$ .

Chicago (Table 9). Clod steaks that were fried by consumers in Philadelphia received the highest Flavor Amount ratings compared to the remaining methods in that city, whereas consumers in Chicago had no clear preference for cooking method.

### Correlations and Regression of Consumer Attributes of Clod Steaks

Simple correlations showed a strong positive relationship between Overall Like ratings and the other consumer palatability attributes (Table 10). Flavor Like was the sensory trait that was the most highly correlated to Overall Like, followed by Tenderness, Flavor Amount, and Juiciness. Flavor desirability of clod steaks was of great importance to consumers. As a way to see whether these correlations were influenced by consumer segment, correlations were generated within segments between the consumer attributes as before (Table 11). It is of particular interest that for Beef Loy-

**Table 11.** Simple correlations of Overall Like ratings with the other consumer ratings for clod steaks stratified by segment<sup>a</sup>

Segment	Tenderness	Juiciness	Flavor Like	Flavor Amount
Beef Loyals	0.75	0.63	0.86	0.80
Budget Rotators	0.89	0.75	0.91	0.85
Variety Rotators	0.76	0.73	0.85	0.75

<sup>a</sup>All correlations are  $P < 0.0001$ .

als, both Flavor Like and Flavor Amount seemed to be more highly correlated to Overall Like than was Tenderness. For Budget Rotators, the correlations of Flavor Like and Tenderness to Overall Like were close and the highest of all comparisons. Finally, the primary difference between the Variety Rotators and Beef Loyals was that Beef Loyals had higher correlations between Flavor Amount and Overall Like than did Variety Rotators.

To determine how the sensory traits interact to form the basis for customer satisfaction, stepwise regression analysis was performed so that the importance of the sensory traits in contributing to Overall Like could be determined (Table 12). For the stepwise analysis, Flavor Like was the first variable to enter into the equation for predicting Overall Like. The  $R^2$  was 0.747. The second variable to enter was Tenderness and the third variable was Flavor Amount. Juiciness did not meet the  $P < 0.15$  significance level requirement for entry into the model.

Clearly, Flavor Like was driving customer satisfaction with the clod steak. This was evident when the correlation and stepwise regression analyses were evaluated. This may be because the tenderness of this cut was comparatively acceptable in this study, allowing consumers the luxury of concentrating on flavor as the basis for their satisfaction with the clod steak. Other recent studies also have reported that flavor may be as important as tenderness in determining consumer satisfaction (Miller et al., 1995a,b; Huffman et al., 1996; Neely et al., 1998).

### Warner-Bratzler Shear Force Determination

No significant differences in Warner-Bratzler shear force were found among the four different grades ( $P = 0.2037$ ) of clod steaks. Generally, the values were quite tender for all four grades (Top Choice = 2.19 kg, Low Choice = 2.25 kg, High Select = 2.34 kg, and Low Select = 2.41 kg). This supports the consumer tenderness ratings findings, wherein no grade differences were observed.

Shackelford et al. (1991) identified a Warner-Bratzler shear force threshold of 4.59 kg for round and chuck cuts to be used as a tenderness benchmark in beef palatability. Other researchers have identified shear force thresholds of 4.3 kg (Miller et al., 1995a) and 4.1 kg (Huffman et al., 1996) according to consumer responses. According to these target thresholds, these clod steaks would be acceptable to consumers regardless of quality grade.

## Discussion

### USDA Quality Grade

The USDA quality grade had no effect on consumer evaluations or shear force values of clod steaks. Previous research has reported no difference in Warner-Brat-

**Table 12.** Stepwise regression for predicting Overall Like ratings for clod steaks with the other consumer ratings<sup>a</sup>

Equation	R <sup>2</sup>	C <sub>p</sub>	Intercept	Flavor Like	Tenderness	Flavor Amount
1	0.747	201.52	1.0695	0.8365		
2	0.781	6.47	0.6931	0.6011	0.2861	
3	0.782	3.00	0.6931	0.5501	0.2823	0.0653

<sup>a</sup>Only variables that met the  $P < 0.15$  significance level are included in the model. No other sensory traits met this entrance requirement.

zler shear force or trained sensory panel ratings due to USDA quality grade in young beef (Romans et al., 1965; Parrish et al., 1973; Smith et al., 1987).

### City

Although geographical location was detected for cooking method, it was not detected for grade, segment, or degree of doneness. Although consumers in both cities most frequently grilled their clod steaks, steaks cooked in this manner received among the lowest palatability ratings in Philadelphia. Consumers in Chicago tended to give more uniform and less differentiated Overall Like ratings among the cooking methods.

Fat trim levels and composition of beef products (Savell et al., 1991), as well as tenderness (Morgan et al., 1991), vary in products available in various cities. Further, regional tastes and preferences may affect consumers' satisfaction with various beef products. The National Consumer Retail Beef Study (Savell et al., 1987) found a significant interaction between marbling and city. In this interaction, marbling was more important to consumers in Philadelphia than to those in San Francisco. Both cities in the present study, Philadelphia and Chicago, are known as U.S. Choice markets, so similarities in their responses to grade were expected.

### Segment

Beef Loyals gave the highest consumer ratings for Overall Like and gave among the highest Flavor Like ratings, whereas Budget Rotators and Variety Rotators gave among the lowest Flavor Like ratings. This follows the correlation data: Flavor Like was highly correlated to Overall Like ratings for the Beef Loyals segment. Consumer segmentation research detailing specific taste preferences must be conducted to better target products to consumers.

### Degree of Doneness

Either as a main effect or interaction effect, degree of doneness affected consumer Tenderness, Juiciness, and Flavor Like ratings. As would be expected, Juiciness ratings were higher for steaks cooked to lower degrees of doneness. Steaks cooked to higher degrees of doneness and prepared using moist-heat methods of

cooking generally rated higher than steaks prepared using dry-heat methods. At higher degrees of doneness, lower juiciness ratings have been reported for cuts from the loin, sirloin, and round by trained sensory panels (Belk et al., 1993; Luchak et al., 1998) and by consumers (Lorenzen et al., 1999; Neely et al., 1999). Belk et al. (1993) also found higher trained sensory panel connective tissue amount ratings for clod roasts at higher temperatures, and Lorenzen et al. (1999) reported that consumers' flavor desirability and flavor intensity ratings of loin steaks were lower at higher degrees of doneness.

### Cooking Method

Cooking method, as an interaction effect with either city or degree of doneness, significantly affected all consumer traits evaluated. Clod steaks that were grilled received low ratings when prepared to medium-well and more degrees of doneness or when prepared by consumers in Philadelphia. Braising received generally high ratings regardless of city or degree of doneness; however, it was used by only 17% of the consumers in this study, presumably due to the long preparation time and cleanup involved. Perhaps prebraised beef products could deliver high satisfaction levels combined with increased convenience.

For each trait evaluated, consumers in Philadelphia consistently gave among the highest ratings to clod steaks that were fried, whereas consumers in Chicago consistently gave steaks cooked in this manner among the lowest ratings. Lorenzen et al. (1999) also found that some cooking methods resulted in higher palatability ratings for top loin steaks in one city than in another. It is unclear why palatability ratings for steaks cooked using different cooking methods differ among cities.

### Implications

Flavor, not tenderness, was most correlated to the overall desirability of clod steaks. Based on the Warner-Bratzler shear force values and consumer tenderness ratings, the clod steak was relatively tender, possibly allowing consumers to concentrate on flavor as their primary basis for satisfaction. Cooking method and degree of doneness greatly influenced customer satisfaction, more than the principal product effect of this

study, grade. The way consumers chose to prepare their steaks heavily influenced how well they enjoyed the product at the dinner table. For the clod steak, it is likely that preparation techniques that improve flavor without reducing tenderness positively affect customer satisfaction.

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