

Beef Customer Satisfaction: Cooking Method and Degree of Doneness Effects on the Top Round Steak¹

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ABSTRACT: The objective of this research was to evaluate the consumer-controlled factors of cooking method and degree of doneness on Top Choice, Low Choice, High Select, and Low Select top round steaks. The in-home product test was conducted in Chicago, Houston, Philadelphia, and San Francisco. Consumers ($n = 2,212$) evaluated each top round steak for overall like (OLIKE), tenderness (TEND), juiciness (JUIC), flavor desirability (DFLAV), and flavor intensity (IFLAV) using 23-point hedonic scales. Stir-frying, braising, and simmering and stewing consistently produced higher consumer attribute ratings. There were clear OLIKE rating differences ($P = .0001$) for

top round steaks among the four cities. The highest ratings were given by consumers in Houston, and the lowest ratings were given by consumers in Philadelphia ($P < .05$). There were two interactions for OLIKE: USDA quality grade \times degree of doneness ($P = .002$) and degree of doneness \times cooking method ($P = .02$). Higher ratings generally were given to steaks cooked to medium rare or less or to very well degrees of doneness. Stir-frying, braising, and simmering and stewing were preferred at lower degrees of doneness. Customer satisfaction with the top round steak is very dependent on how it is cooked and by whom it is consumed.

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

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J. Anim. Sci. 1999. 77:653-660

Introduction

Neely et al. (1998) reported that top round steaks ranked the lowest in overall consumer ratings compared to top loin and top sirloin steaks. These findings are supported by the Warner-Bratzler shear force and trained sensory panel data reported in the National Beef Tenderness Survey (Morgan et al., 1991).

It should not be surprising that top round steaks would have lower consumer ratings and higher shear force values than cuts from the rib and loin. Cuts from the round have higher connective tissue levels than cuts from the rib and loin because the muscles are used differently (Lawrie, 1998). Because of the high connective tissue content of round muscles, moist heat cooking methods have been recommended as most appropriate for cooking steaks from the round. However, Savell et al. (1989) found that a majority of consumers in Philadelphia cooked top round steaks with either outdoor grilling or broiling, resulting in low consumer ratings. The top round steak presents a real challenge to the beef industry because it is lean and has an attractive appearance, leading many consumers to cook it as they would a cut from the rib or loin, only to be dissatisfied with the final product.

This article, which focuses on the palatability of top round steak, is the third in a series dealing with in-home cooking methods and degree of doneness used by beef consumers in four cities. These consumer-controlled factors were evaluated in combination with city and USDA quality grade.

¹This study was supported, in part, by the Cattlemen's Beef Promotion and Research Board through the National Live Stock and Meat Board (now known as the National Cattlemen's Beef Association). Appreciation is extended to Miriam Schiller, Douglas F. Haley, and Judy Dyer from Yankelovich Partners, Inc., and John Bellinger, Agri-West International, for their contributions to the research project.

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Received March 16, 1998.

Accepted October 6, 1998.

Materials and Methods

This study is an extension of the Beef Customer Satisfaction Study; carcass selection, steak processing, and consumer recruitment followed procedures described by Neely et al. (1998). Briefly, Top Choice,

Low Choice, High Select, and Low Select carcasses (n = 150 each) were selected from three packing facilities in Colorado, Texas, and Nebraska, and the strip loin, top sirloin, and top (inside) round subprimals from each side were obtained. Steaks from each subprimal were cut, packaged, frozen, and shipped to consumer

Table 1. Consumer rating means (standard deviations) within USDA quality grade, city, degree of doneness, and cooking method

| | Consumer ratings ^a | | | | |
|---------------------|-------------------------------|---------------|---------------|---------------|---------------|
| | OLIKE | TEND | JUIC | DFLAV | IFLAV |
| USDA quality grade | | | | | |
| Top Choice | 16.3 (4.7) | 15.8 (5.2) | 15.4 (5.2) | 16.7 (4.7) | 16.8 (4.5) |
| Low Choice | 16.0 (4.8) | 15.5 (5.4) | 15.1 (5.4) | 16.5 (4.9) | 16.6 (4.7) |
| High Select | 15.7 (5.1) | 15.3 (5.6) | 14.9 (5.5) | 16.3 (5.0) | 16.5 (4.9) |
| Low Select | 15.8 (5.0) | 15.2 (5.5) | 14.7 (5.5) | 16.3 (4.9) | 16.3 (4.7) |
| City | | | | | |
| Chicago | 16.1 (5.1) | 15.7 (5.5) | 15.3 (5.5) | 16.5 (5.1) | 16.6 (4.9) |
| Houston | 17.2 (4.4) | 16.6 (4.9) | 16.2 (5.0) | 17.7 (4.2) | 17.7 (4.2) |
| Philadelphia | 15.0 (5.2) | 14.4 (5.7) | 14.1 (5.6) | 15.6 (5.2) | 15.8 (5.1) |
| San Francisco | 15.7 (4.7) | 15.2 (5.3) | 14.5 (5.3) | 16.1 (4.8) | 16.2 (4.5) |
| Degree of doneness | | | | | |
| Medium rare or less | 15.6 (5.4) | 15.1 (5.7) | 16.0 (5.1) | 16.2 (5.2) | 16.4 (5.0) |
| Medium | 15.8 (4.7) | 15.2 (5.3) | 15.7 (4.9) | 16.4 (4.8) | 16.5 (4.6) |
| Medium well | 15.7 (5.0) | 15.2 (5.3) | 14.9 (5.2) | 16.2 (4.9) | 16.3 (4.8) |
| Well done | 16.2 (4.7) | 15.5 (5.3) | 14.8 (5.4) | 16.6 (4.7) | 16.6 (4.6) |
| Very well done | 16.3 (5.1) | 16.1 (5.7) | 14.5 (6.1) | 16.6 (5.1) | 16.7 (4.9) |
| Cooking method | | | | | |
| Broil | 15.0 (5.5) | 14.4 (5.9) | 14.2 (5.9) | 15.5 (5.5) | 15.8 (5.3) |
| Outdoor grill | 15.2 (5.2) | 14.4 (5.6) | 14.6 (5.5) | 16.0 (5.0) | 16.2 (5.0) |
| Pan-fry | 16.0 (4.9) | 15.3 (5.5) | 15.1 (5.3) | 16.4 (5.0) | 16.5 (4.8) |
| Stir-fry | 16.2 (4.4) | 15.4 (5.0) | 15.0 (5.0) | 16.6 (4.3) | 16.5 (4.4) |
| Pan-broil | 16.3 (5.2) | 15.7 (5.5) | 15.6 (5.5) | 16.4 (5.3) | 16.6 (5.1) |
| Braise | 15.9 (4.4) | 15.6 (5.1) | 14.4 (5.4) | 16.4 (4.5) | 16.3 (4.4) |
| Simmer and stew | 16.8 (4.2) | 16.9 (4.7) | 15.6 (5.1) | 17.2 (4.3) | 17.1 (4.3) |
| Other ^b | 16.6 (5.0) | 16.2 (5.5) | 15.1 (5.7) | 17.0 (4.9) | 17.1 (4.6) |

^aOLIKE = overall like, TEND = tenderness, JUIC = juiciness, DFLAV = flavor desirability, and IFLAV = flavor intensity. Consumers used a 23-point hedonic scale: 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.

^bOther cooking methods included indoor grill, oven-roasted uncovered, and deep-fry. These cooking methods were used infrequently by the consumers in this study.

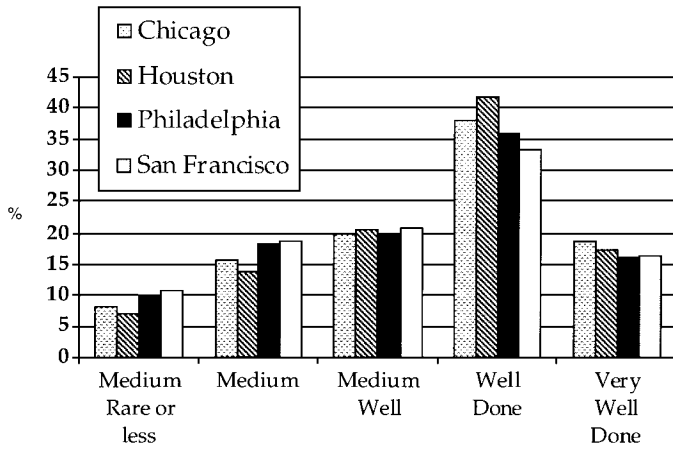


Figure 1. Degree of doneness frequency distributions for beef top round steaks stratified by city.

households (n = 300 in each city) in Houston, Chicago, Philadelphia, and San Francisco. Each household had two respondents who evaluated steaks, for a total of 600 consumers in each city and 2,400 consumers in the study (2,212 consumers completed the study).

In-Home Product Test

Only consumer responses for top round steaks are discussed. Respondents (two per household) were asked to prepare the steaks as they would when buying the same cuts in the supermarket; no instructions were given for beef preparation. The preparer was asked how the beef was cooked and was given choices among different dry heat (outdoor grill, indoor grill, broil, oven-roasted uncovered, pan-broil, pan-fry, and stir-fry), moist heat (braise and simmer and

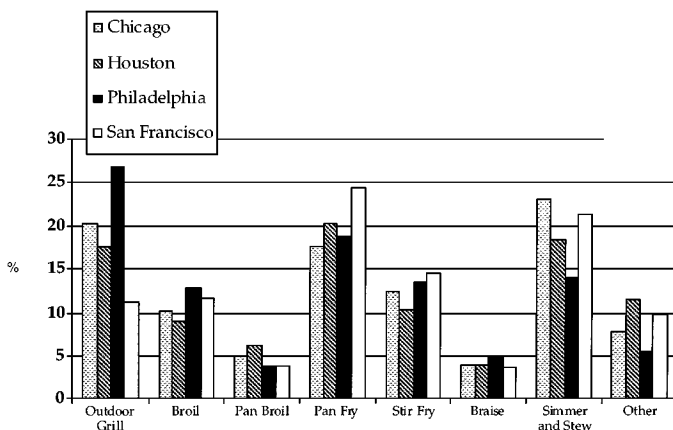


Figure 2. Cooking method frequency distributions for beef top round steaks stratified by city. Other cooking methods include indoor grill, oven-roasted uncovered, and deep-fry. These methods were used infrequently by the consumers in this study.

Table 2. Least squares means for city effect on overall like ratings (23 = like extremely; 1 = dislike extremely)

| Chicago | Houston | Philadelphia | San Francisco |
|-------------------|-------------------|-------------------|-------------------|
| 17.2 ^b | 17.9 ^a | 16.3 ^d | 16.6 ^c |

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

stew), and other (deep-fry) methods (National Live Stock and Meat Board, 1992).

Consumers evaluated each top round 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 unadjusted main effect means and standard deviations of OLIKE, TEND, JUIC, DFLAV, and IFLAV by USDA quality grade, city, degree of doneness, and cooking method are presented in Table 1. Each respondent completed separate evaluation forms and was instructed to complete the evaluation form immediately following the meal. Each evaluation form also included a question relative to the degree of doneness of the steaks at the time of consumption. Participants used the National Live Stock and Meat Board beef steak color guide as an aid and 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. The questionnaire completed by the primary preparer/shopper included an additional sheet of preparation information using standardized preparation definitions (National Live Stock and Meat Board, 1992).

Data Analysis

The statistical model for consumer satisfaction ratings included main effects of city, USDA quality

Table 3. Least squares means for degree of doneness × USDA quality grade effect on overall like ratings (23 = like extremely; 1 = dislike extremely)

| Degree of doneness | USDA quality grade | | | |
|---------------------|----------------------|----------------------|-----------------------|----------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Medium rare or less | 17.5 ^{ab} | 17.5 ^{abc} | 17.5 ^a | 17.4 ^{abc} |
| Medium | 17.4 ^{abc} | 16.9 ^{abcd} | 16.8 ^{abcde} | 16.7 ^{bcde} |
| Medium well | 16.5 ^{de} | 16.5 ^{de} | 16.7 ^{bcde} | 16.7 ^{cde} |
| Well done | 17.4 ^{abc} | 16.9 ^{abcd} | 16.3 ^e | 16.7 ^{cde} |
| Very well done | 16.9 ^{abcd} | 17.3 ^{abc} | 17.2 ^{abc} | 16.9 ^{abcd} |

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

Table 4. Least squares means for degree of doneness \times cooking method effect on overall like ratings (23 = like extremely; 1 = dislike extremely)

| Cooking method | Degree of doneness | | | | |
|--------------------|---------------------|---------------------|--------------------|---------------------|---------------------|
| | Medium rare or less | Medium | Medium well | Well done | Very well done |
| Broil | 17.3 ^{bc} | 16.7 ^c | 15.8 ^c | 16.0 ^c | 16.4 ^c |
| Outdoor grill | 16.3 ^c | 16.2 ^c | 16.1 ^c | 16.1 ^c | 16.7 ^c |
| Pan-fry | 17.0 ^{bc} | 16.7 ^c | 17.0 ^c | 16.6 ^c | 17.2 ^{bc} |
| Stir-fry | 18.3 ^{ab} | 16.9 ^c | 16.9 ^c | 17.0 ^c | 17.4 ^{bc} |
| Pan-broil | 17.5 ^{bc} | 16.7 ^c | 16.4 ^c | 17.0 ^{bc} | 17.7 ^{abc} |
| Braise | 17.9 ^{abc} | 17.5 ^{bc} | 16.2 ^c | 16.8 ^c | 17.1 ^{bc} |
| Simmer and stew | 19.2 ^a | 17.9 ^{abc} | 17.1 ^{bc} | 17.5 ^{bc} | 17.4 ^{bc} |
| Other ^d | 16.1 ^c | 17.2 ^{bc} | 17.1 ^{bc} | 17.6 ^{abc} | 16.7 ^c |

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

^dOther cooking methods included indoor grill, oven-roasted uncovered, and deep-fry. These cooking methods were used infrequently by the consumers in this study.

Table 5. Least squares means for degree of doneness \times USDA quality grade effect on tenderness ratings (23 = extremely tender; 1 = not at all tender)

| Degree of doneness | USDA quality grade | | | |
|---------------------|---------------------|---------------------|---------------------|---------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Medium rare or less | 17.3 ^a | 17.0 ^{ab} | 17.0 ^{abc} | 17.0 ^{ab} |
| Medium | 17.2 ^a | 16.4 ^{bc} | 16.6 ^{abc} | 16.5 ^{abc} |
| Medium well | 15.8 ^c | 16.1 ^c | 16.2 ^{bc} | 16.1 ^c |
| Well done | 17.0 ^{abc} | 16.5 ^{abc} | 15.7 ^c | 16.1 ^c |
| Very well done | 16.4 ^{bc} | 16.7 ^{abc} | 17.0 ^{abc} | 16.4 ^{bc} |

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

grade, degree of doneness, and cooking method and their two-way interactions. In addition, steak location nested within cut, week nested within city, and animal nested within USDA quality grade and packing facility were included in the model.

Statistical analyses were performed using SAS (1991). For all 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 of SAS (1991). Only significant terms ($P < .05$) were retained in the model. Frequency distributions were generated for degree of doneness and cookery method within city for top round steaks.

Results

Frequency distributions of degree of doneness and cookery method by city are presented in Figures 1 and 2. Because not all cooking methods and degrees of doneness were used frequently, some categories were combined. "Other" cookery methods included indoor

Table 6. Least squares means for cooking method \times degree of doneness effect on tenderness ratings (23 = extremely tender; 1 = not at all tender)

| Cooking method | Degree of doneness | | | | |
|--------------------|---------------------|---------------------|--------------------|---------------------|---------------------|
| | Medium rare or less | Medium | Medium well | Well done | Very well done |
| Broil | 17.1 ^{abc} | 16.3 ^{bc} | 15.3 ^c | 15.3 ^c | 15.3 ^c |
| Outdoor grill | 15.7 ^c | 15.7 ^c | 15.6 ^c | 15.0 ^c | 15.6 ^c |
| Pan-fry | 16.2 ^{bc} | 15.9 ^c | 16.6 ^{bc} | 16.0 ^{bc} | 16.7 ^{bc} |
| Stir-fry | 18.2 ^a | 16.4 ^{bc} | 16.3 ^{bc} | 16.3 ^{bc} | 16.4 ^{bc} |
| Pan-broil | 17.0 ^{abc} | 16.2 ^{bc} | 15.9 ^c | 16.4 ^{bc} | 17.0 ^{abc} |
| Braise | 17.6 ^{abc} | 17.9 ^{ab} | 15.8 ^c | 16.5 ^{bc} | 17.2 ^{abc} |
| Simmer and stew | 18.8 ^a | 17.9 ^a | 16.6 ^{bc} | 17.4 ^{abc} | 17.9 ^a |
| Other ^d | 15.9 ^c | 16.8 ^{abc} | 16.3 ^{bc} | 17.6 ^{abc} | 16.6 ^{bc} |

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

^dOther cooking methods included indoor grill, oven-roasted uncovered, and deep-fry. These cooking methods were used infrequently by the consumers in this study.

Table 7. Least squares means for cooking method × city effect on tenderness ratings (23 = extremely tender; 1 = not at all tender)

| Cooking method | City | | | |
|--------------------|----------------------|----------------------|-----------------------|-----------------------|
| | Chicago | Houston | Philadelphia | San Francisco |
| Broil | 15.9 ^{efgh} | 17.3 ^{bc} | 15.2 ^{ghi} | 15.0 ^{hi} |
| Outdoor grill | 15.8 ^{efgh} | 16.7 ^{cde} | 14.7 ⁱ | 14.8 ⁱ |
| Pan-fry | 16.2 ^{defg} | 17.4 ^b | 15.6 ^{fgh} | 15.8 ^{efgh} |
| Stir-fry | 17.0 ^{bcde} | 17.8 ^{ab} | 15.4 ^{ghi} | 16.7 ^{cde} |
| Pan-broil | 17.1 ^{bcd} | 17.3 ^{bc} | 16.3 ^{cdefg} | 15.3 ^{ghi} |
| Braise | 18.2 ^{ab} | 17.0 ^{bcde} | 16.4 ^{cdefg} | 16.5 ^{cdefg} |
| Simmer and stew | 18.0 ^{ab} | 18.4 ^a | 17.0 ^{bcde} | 17.5 ^b |
| Other ^j | 17.0 ^{bcde} | 17.0 ^{bcd} | 16.5 ^{cdef} | 16.1 ^{defg} |

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

^jOther cooking methods included indoor grill, oven-roasted uncovered, and deep-fry. These cooking methods were used infrequently by the consumers in this study.

grill, oven-roasted uncovered, and deep-fry. For all cities, well done was the degree of doneness most frequently reported for top round steaks (Figure 1). Consumers in Philadelphia most often cooked the steaks with outdoor grilling, and those in Chicago used simmer and stew (Figure 2). Consumers in San Francisco and Houston most often used pan-frying.

Consumer Overall Like Ratings

There were clear and distinct OLIKE ratings differences ($P = .0001$) for top round steaks among the four cities (Table 2). The highest ratings were given by consumers in Houston, and the lowest ratings were given by consumers in Philadelphia ($P < .05$).

There were two interactions for OLIKE: USDA quality grade × degree of doneness ($P = .002$) and degree of doneness × cooking method ($P = .02$). Higher ratings generally were given to steaks cooked to medium rare or less or to very well degrees of doneness, and to those steaks from the Top Choice

Table 8. Least squares means for degree of doneness × USDA quality grade effect on juiciness ratings (23 = extremely juicy; 1 = not at all juicy)

| Degree of doneness | USDA quality grade | | | |
|---------------------|---------------------|----------------------|----------------------|----------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Medium rare or less | 17.5 ^a | 17.4 ^{ab} | 17.0 ^{abc} | 17.0 ^{abc} |
| Medium | 17.2 ^{ab} | 16.6 ^{bcd} | 16.8 ^{abc} | 16.3 ^{cde} |
| Medium well | 15.4 ^{ghi} | 15.5 ^{fghi} | 16.0 ^{defg} | 15.6 ^{efgh} |
| Well done | 16.0 ^{def} | 15.6 ^{fgh} | 15.0 ⁱ | 15.2 ^{hi} |
| Very well done | 15.3 ^{ghi} | 15.1 ^{hi} | 15.6 ^{fghi} | 15.1 ^{hi} |

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

category, regardless of degree of doneness (Table 3). The cooking methods of simmer and stew, braising, and stir-fry were preferred at the lower (medium rare or less) degrees of doneness (Table 4).

Consumer Tenderness Ratings

There were three interactions for TEND ratings: USDA quality grade × degree of doneness ($P = .0005$), cooking method × degree of doneness ($P = .0001$), and city × cooking method ($P = .02$). No clear trend for TEND ratings can be found in comparing the effect of degree of doneness within USDA quality grades (Table 5).

Effects of degree of doneness × cooking method are presented in Table 6. Degree of doneness did not affect ($P > .05$) TEND when steaks were cooked by broiling, outdoor grilling, pan-frying, pan-broiling, or “other” methods. Steaks cooked by stir-frying to medium rare or less had higher TEND ratings than steaks cooked to the other degrees of doneness. For most cooking methods, steaks cooked to medium well tended to have the lowest TEND ratings. For most cooking methods, steaks prepared by consumers in Houston tended to have the highest TEND ratings (Table 7).

Consumer Juiciness Ratings

Three interactions were found for JUIC ratings: USDA quality grade × degree of doneness ($P = .005$), city × degree of doneness ($P = .03$), and cooking method × degree of doneness ($P = .01$). As degree of doneness increased, USDA quality grade had little effect on JUIC ratings (Table 8).

Generally, consumers in Chicago and Houston rated steaks higher for JUIC regardless of degree of doneness (Table 9). In addition, for all cities, steaks cooked to lower degrees of doneness had higher JUIC ratings ($P < .05$, Table 9).

Degree of doneness did not affect ($P > .05$) JUIC ratings when steaks were stir-fried, pan-broiled, or simmered and stewed (Table 10). For the other cooking methods, JUIC ratings decreased ($P < .05$) with increased degrees of doneness.

Table 9. Least squares means for degree of doneness × city effect on juiciness ratings (23 = extremely juicy; 1 = not at all juicy)

| Degree of doneness | City | | | |
|---------------------|-------------------|---------------------|--------------------|--------------------|
| | Chicago | Houston | Philadelphia | San Francisco |
| Medium rare or less | 17.9 ^a | 17.9 ^a | 16.5 ^{cd} | 16.7 ^c |
| Medium | 16.7 ^c | 17.4 ^{ab} | 16.3 ^{cd} | 16.4 ^{cd} |
| Medium well | 15.8 ^d | 17.0 ^{abc} | 14.7 ^{ef} | 15.0 ^{de} |
| Well done | 15.9 ^d | 16.5 ^c | 14.6 ^{ef} | 14.7 ^{ef} |
| Very well done | 15.8 ^d | 16.8 ^{bc} | 14.2 ^f | 14.1 ^f |

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

Table 10. Least squares means for cooking method \times degree of doneness effect on juiciness ratings (23 = extremely juicy; 1 = not at all juicy)

| Cooking method | Degree of doneness | | | | |
|--------------------|---------------------|---------------------|----------------------|----------------------|----------------------|
| | Medium rare or less | Medium | Medium well | Well done | Very well done |
| Broil | 17.1 ^a | 16.1 ^{abc} | 14.9 ^{def} | 14.5 ^{def} | 14.7 ^{def} |
| Outdoor grill | 16.7 ^{ab} | 16.0 ^{ab} | 15.2 ^{cde} | 14.4 ^{ef} | 14.2 ^{ef} |
| Pan-fry | 16.7 ^{ab} | 16.3 ^{ab} | 16.2 ^{ab} | 15.3 ^{cde} | 15.5 ^{bcd} |
| Stir-fry | 17.8 ^a | 16.5 ^{ab} | 15.8 ^{abc} | 15.7 ^{abcd} | 16.2 ^{ab} |
| Pan-broil | 16.8 ^{ab} | 16.4 ^{ab} | 15.4 ^{bcde} | 16.1 ^{abc} | 15.7 ^{abcd} |
| Braise | 18.6 ^a | 17.6 ^a | 15.8 ^{abcd} | 15.1 ^{def} | 15.6 ^{abcd} |
| Simmer and stew | 17.6 ^a | 16.5 ^{ab} | 15.9 ^{abc} | 16.3 ^{ab} | 16.2 ^{ab} |
| Other ^g | 16.6 ^{ab} | 16.9 ^a | 15.7 ^{abcd} | 14.4 ^{ef} | 14.1 ^f |

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

^gOther cooking methods included indoor grill, oven-roasted uncovered, and deep-fry. These cooking methods were used infrequently by the consumers in this study.

Table 11. Least squares means for cooking method effect on flavor desirability ratings (23 = like extremely; 1 = dislike extremely)

| Broil | Outdoor grill | Pan-fry | Stir-fry | Pan-broil | Braise | Simmer and stew | Other ^a |
|-------------------|-------------------|-------------------|-------------------|--------------------|-------------------|-------------------|--------------------|
| 17.0 ^d | 17.0 ^d | 17.4 ^c | 17.6 ^c | 17.3 ^{cd} | 17.5 ^c | 18.0 ^b | 17.7 ^c |

^aOther cooking methods included indoor grill, oven-roasted uncovered, and deep-fry. These cooking methods were used infrequently by the consumers in this study.

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

Consumer Flavor Desirability and Intensity Ratings

Simmering and stewing produced the highest and broiling and outdoor grilling produced the lowest ($P < .05$) DFLAV ratings (Table 11). Consumers in Houston rated round steaks highest ($P < .05$) for DFLAV and IFLAV (Tables 12 and 13, respectively).

For DFLAV and IFLAV ratings, one common interaction was found: USDA quality grade \times degree of doneness ($P = .007$ and $.001$, respectively). The USDA

quality grade did not affect ($P > .05$) DFLAV ratings when steaks were cooked well done (Table 14).

The USDA quality grade did not affect ($P > .05$) IFLAV ratings for steaks cooked to medium rare or less or to medium well end points (Table 15). Top Choice, top round steaks had higher IFLAV ratings than Select steaks ($P < .05$) for steaks cooked well done.

In addition, for IFLAV there was an interaction with cooking method \times degree of doneness ($P = .02$, Table 16). No obvious trend was observed.

Table 12. Least squares means for city effect on flavor desirability ratings (23 = like extremely; 1 = dislike extremely)

| Chicago | Houston | Philadelphia | San Francisco |
|-------------------|-------------------|-------------------|-------------------|
| 17.5 ^b | 18.3 ^a | 16.8 ^c | 17.0 ^c |

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

Table 13. Least squares means for city effect on flavor intensity ratings (23 = extreme amount; 1 = none at all)

| Chicago | Houston | Philadelphia | San Francisco |
|-------------------|-------------------|-------------------|-------------------|
| 17.6 ^b | 18.4 ^a | 17.0 ^c | 17.0 ^c |

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

Table 14. Least squares means for degree of doneness \times USDA quality grade effect on flavor desirability ratings (23 = like extremely; 1 = dislike extremely)

| Degree of doneness | USDA quality grade | | | |
|---------------------|----------------------|----------------------|----------------------|----------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Medium rare or less | 17.6 ^{abcd} | 17.8 ^{ab} | 17.7 ^{abc} | 17.6 ^{abcd} |
| Medium | 17.8 ^{ab} | 17.6 ^{abc} | 17.5 ^{abcd} | 17.3 ^{bcd} |
| Medium well | 17.0 ^{de} | 17.1 ^{cde} | 17.4 ^{bcd} | 17.2 ^{bcd} |
| Well done | 17.9 ^a | 17.4 ^{bcd} | 16.9 ^e | 17.1 ^{cde} |
| Very well done | 17.2 ^{bcd} | 17.4 ^{abcd} | 17.5 ^{abcd} | 17.3 ^{bcd} |

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

Table 15. Least squares means for degree of doneness × USDA quality grade effect on flavor intensity ratings (23 = extreme amount; 1 = none at all)

| Degree of doneness | USDA quality grade | | | |
|---------------------|----------------------|-----------------------|-----------------------|----------------------|
| | Top Choice | Low Choice | High Select | Low Select |
| Medium rare or less | 17.8 ^{ab} | 18.0 ^a | 18.0 ^a | 17.7 ^{abc} |
| Medium | 18.0 ^a | 17.5 ^{abcd} | 17.5 ^{abc} | 17.4 ^{abcd} |
| Medium well | 16.8 ^e | 17.1 ^{bcde} | 17.3 ^{abcde} | 17.0 ^{de} |
| Well done | 17.9 ^a | 17.5 ^{abc} | 17.0 ^{cde} | 17.2 ^{bcde} |
| Very well done | 17.4 ^{abcd} | 17.4 ^{abcde} | 17.9 ^a | 17.4 ^{abcd} |

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

Discussion

USDA Quality Grade

The USDA quality grade had very little effect on consumer evaluations of the top round. Previously, Smith et al. (1987) reported no difference in Warner-Bratzler shear force or trained sensory panel ratings due to USDA quality grade in young beef.

City

As reported in Neely et al. (1998), consumers in Houston tended to rate top round steaks higher for all attributes than did those in Chicago, Philadelphia, or San Francisco.

Unlike for top loin steaks (Lorenzen et al., 1999, geographical differences were not detected for degree of doneness in top round steaks. However, consumers in the three cities prepared the steaks very differently. The difference in cooking method may partially explain why Houston rated top round steaks higher; consumers in Houston used pan-frying, stir-frying,

and simmering and stewing more often than dry heat methods.

Philadelphia presents an interesting challenge. Savell et al. (1989) reported that outdoor grilling or broiling were the most frequent cooking methods used by consumers in Philadelphia for top round steaks. In this study, these two cooking methods consistently received the lowest consumer ratings. Two different studies using consumers in Philadelphia and conducted close to a decade apart reveal similar findings. Through whatever methods possible, consumers in Philadelphia should be informed about the most appropriate methods to cook top round steaks.

Degree of Doneness

Top round steaks were most frequently cooked well done. This overall higher degree of doneness may be partially responsible for the lower OLIVE ratings for top round steaks than for top loin and top sirloin steaks (Neely et al., 1998).

Top round steaks cooked to medium-well degrees of doneness received lower consumer ratings than steaks cooked to medium and well done degrees of doneness. Generally, consumer tenderness and juiciness ratings decreased with increased degrees of doneness. Belk et al. (1993) reported lower panel juiciness and myofibrillar tenderness scores for inside round roasts cooked to higher end point temperatures.

Cooking Method

The cooking methods of stir-fry, braise, and simmer and stew produced higher ratings for all consumer attributes than did dry heat methods. Cooking methods that allow moist heat to be generated result in higher consumer ratings for top round steaks. Work must be done to show consumers that outdoor grilling and broiling are cooking methods that should not be used to prepare top round steaks.

Table 16. Least squares means for cooking method × degree of doneness effect on flavor intensity ratings (23 = extreme amount; 1 = none at all)

| Cooking method | Degree of doneness | | | | |
|--------------------|---------------------|--------------------|--------------------|--------------------|--------------------|
| | Medium rare or less | Medium | Medium well | Well done | Very well done |
| Broil | 17.9 ^a | 17.3 ^{ab} | 16.7 ^b | 16.6 ^b | 17.6 ^{ab} |
| Outdoor grill | 17.5 ^{ab} | 17.3 ^{ab} | 17.1 ^b | 16.9 ^b | 17.2 ^{ab} |
| Pan-fry | 17.5 ^{ab} | 17.4 ^{ab} | 17.5 ^{ab} | 17.2 ^{ab} | 17.5 ^{ab} |
| Stir-fry | 18.4 ^a | 17.4 ^{ab} | 17.4 ^{ab} | 17.3 ^{ab} | 17.6 ^{ab} |
| Pan-broil | 17.6 ^{ab} | 17.2 ^{ab} | 16.4 ^b | 18.0 ^a | 17.5 ^{ab} |
| Braise | 18.9 ^a | 17.9 ^{ab} | 16.4 ^b | 17.2 ^{ab} | 17.6 ^{ab} |
| Simmer and stew | 18.5 ^a | 18.3 ^a | 17.5 ^{ab} | 17.9 ^a | 17.9 ^a |
| Other ^c | 16.6 ^b | 18.0 ^a | 17.4 ^{ab} | 18.1 ^a | 17.2 ^{ab} |

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

^cOther cooking methods included indoor grill, oven-roasted uncovered, and deep-fry. These cooking methods were used infrequently by the consumers in this study.

Implications

The greatest challenge facing the beef industry in marketing the top round steak is to persuade consumers to prepare this cut with moist heat rather than dry heat cookery. Cultural differences most likely exist in attitudes toward the top round steak. Consumers in Houston cooked it with more appropriate methods and rated it the highest, and consumers in Philadelphia cooked it with less appropriate methods and rated it the lowest. Customer satisfaction with the top round steak is very dependent on how it is cooked and by whom it is consumed.

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