St. Louis Consumers' Eating Preferences For Beef Loin Steaks

ELMER R. KIEHL, V. JAMES RHODES, D. E. BRADY, H. D. NAUMANN

TABLE OF CONTENTS

ACKNOWLEDGMENTS

SUMMARY

Studies of *visual* preferences have revealed considerable popularity of lean beef. This bulletin reports on a study of preferences based on satisfaction from *eating* steaks. A total of 266 St. Louis households served as testers for loin steaks from 126 carcasses of various federal grades and shear strengths.

Consumer preferences were definitely related to grade and to some extent to shear. Loins from 21 cattle were included in each grade specified in the summary below. $Choice_0$, $Choice_1$, and $Choice_2$ were of identical grade and weight; $Choice_0$ was compared with Commercial (now Standard); $Choice_1$ was compared with $Choice_2$; Prime was compared with Good. Of 63 loin comparisons there were no unanimous preferences for a single pair. Every loin pair was tasted twice by two adult tasters in either 12 or 14 households. Percentages consistently preferring a grade (for both replicates) and those showing inconsistency of preference between replicates were:

Standard	6.85	Good	7.37	$Choice_1$	23.96
$Choice_0$	57.26	Prime	47.41	$Choice_2$	23.95
Inconsistent	35.89	Inconsistent	45.22	Inconsistent	52.09
	100.00		100.00		100.00

Number of loins in a grade consistently preferred by the men in 8 or more of 12 to 14 households were:

8 $Choice_0$	3 Prime	1 $Choice_1$
0 Standard	0 Good	1 $Choice_2$

Number of loins in a grade consistently preferred by the husbands in 5 to 7 households were:

9 $Choice_0$	11 Prime	2 $Choice_1$
1 Standard	0 Good	3 $Choice_2$

Number of loins in a grade not consistently preferred by the husbands in as many as 5 households were:

4 $Choice_0$	7 Prime	18 $Choice_1$
20 Standard	21 Good	17 $Choice_2$

Thus, the fatter loins were generally preferred to the leaner loins or were considered just as good. Invariably, there were a few people who preferred the fatter grade loin in one test and the leaner grade loin in the replicate test. Inconsistent preferences were so frequent that 4 $Choice_0$ and 7 Prime loins were not preferred by as many as 5 men. The large number of inconsistent preferences suggests that the acceptance differences between many of the fatter and leaner loins were very small.

There is little doubt that a "grade" of leaner carcasses just as acceptable as Choice could be secured if an accurate sorting method were available. Perhaps improved methods of tenderization will someday greatly enlarge the proportion of leaner loins and other cuts which are acceptable. This would almost certainly reduce the amount of fattening of cattle.

The simple coefficient of correlation of the mean shear difference between a pair of loins and the number of inconsistent preferences was -0.54. There was little relation of preferences to cooking method, degree of doneness, or socio-economic characteristics of the sample. Preferences were definitely related to acceptance ratings but had an extremely weak relation to laboratory trio discrimination tests.

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INTRODUCTION

"Though we live in the Age of the Pollster, it must still be defended that, in Art, simply to have an opinion is nothing: to have earned it by the happy involvement of one's attention is all."[1]* Thus a poet recently resisted the invasion of the pollster. Whatever the case may be in Art, it is becoming obvious in marketing that consumer opinions backed by effective demand are important regardless of how such opinions have been acquired. To know consumer opinions is important whether one's motivation is to change them or to serve them.

This study is part of a major research program in consumer acceptance and preferences which has as its objective a better understanding of what consumers generally wish in beef. Recognition that foods as well as other products must be designed for maximum acceptability to consumers is gaining in the food industry.

The first publication[2] in this series reported on a small sales experiment and interviewing study conducted in 1952 in Columbia, Mo. Among the tentative conclusions were the following:

"1. When cuts of the full range of grades are offered at equal prices, a majority of consumers tend to select cuts of the lower grades of beef.

2. Many consumers are not acquainted with the differentiating grade characteristics of beef as they appear in the retail cut.

3. Most consumers are not able to evaluate the relative importance of the various visual physical characteristics of beef in terms of eating satisfaction.

4. A majority of consumers are not acquainted with the U. S. grade terms for beef or the ordering or ranking of these terms."

The second bulletin[3] reported on a large study of visual preferences for beef among St. Louis consumers in 1954. Preferences for loin steaks in a four-grade display were distributed as follows: Prime, 31.7%; Choice, 24.3%; Good, 21.9%; Commercial, 15.4%; and no preference (at equal prices), 6.7%. The distribution of preferences for chuck roasts was quite similar except that the leaner grades were more popular.

"The order in importance of preferences for the various physical attributes of roasts as influences upon the over-all grade preferences was (1) amount of internal fat (other than marbling), (2) color of lean, (3) amount of marbling, (4) amount of external fat, (5) color of fat, (6) amount of bone. The order in

*Numbers refer to references in the back.

importance of the attributes of steaks was (1) amount of external fat, (2) color of lean, (3) marbling, (4) texture, (5) color of fat, and (6) amount of bone."[3]

"Answers to questions concerning consumer desires showed that tenderness was the eating characteristic of steaks and roasts most desired by a majority of people. Tenderness was most often named as the characteristic found lacking in roasts and steaks."[3]

"Eating preferences of consumers for various types of the more popular cuts of beef need to be investigated. Inferring eating quality of beef from its visual appearance is difficult for the expert and almost impossible for most consumers. Therefore, the study of visual preferences, alone, is insufficient for solving the over-all problem of maximum consumer satisfaction. Since there is probably much intra-grade heterogeneity of eating quality, the eating preference tests might be improved by using 'types of product' that have other boundaries in addition to, or instead of, grade boundaries."[3]

Recognition of the limitations of visual preference studies led to the tests of eating discrimination reported in the third bulletin in this series.[4]

"Eating differences were found in the loin steaks from different cattle in only about half of the tests in this study. The occurrence of these eating differences was not strongly related to present federal carcass grades. Comparison of loins from cattle *within* various grades indicated that judges distinguished differences between:

1. 7 of 10 pairs of Commercial loins tested.
2. 2 of 10 pairs of Good loins tested.
3. 3 of 10 pairs of Choice loins tested.
4. 4 of 10 pairs of Prime loins tested.

"While there is a lack of eating homogeneity within grades, there is less heterogeneity between non-adjoining grades than might be anticipated. Comparison of loins from cattle between various grades indicated that judges distinguished differences between:

1. 7 of 20 pairs of Choice-Commercial loins tested.
2. 11 of 20 pairs of Prime-Good loins tested."[4]

The fourth bulletin[5] reported on a large-scale study of the consumer acceptability of beef loins in Metropolitan St. Louis. The companion study of preferences is reported in this bulletin. The preference and acceptance analyses are separated for convenience of presentation and not because they are unrelated. Both bulletins might profitably be read together.

The research project reported here had three major objectives:

1. To estimate the eating preferences of consumers between loin steaks from several grades of beef carcasses.

2. To estimate the ability of consumers to discriminate between loin steaks from different carcasses.

3. To estimate the relationships of preferences and discriminations to cook-

ing methods, degree of doneness, and socio-economic characteristics of respondents.

The first phase of this report describes a small panel conducted to develop research techniques or attack the described objectives. The second phase describes the research techniques and results of a large panel conducted in St. Louis.

COLUMBIA PILOT EATING PREFERENCE PANEL[6]

In April and May, 1955, loin steaks of seven different specifications were compared by 82 Columbia consumers in a series of 14 eating tests. Adults in each household cooked, ate, and evaluated a pair of steaks twice a week. They also expressed a preference for one of the pair.

This pilot study was designed to test several aspects of schedule design and product handling as well as the general feasibility of a consumer sensory panel. While the panel was selected by probability sampling, it was too small to allow reliable inference to the population of Columbia.

The products tested and order of testing of the duo tests are indicated in Table 1. Every comparison involved two replicates. In addition, two trio comparisons of Prime Md. and Good Md. were made. Forty-eight pairs of short loins were purchased from packers and processed at the University Meats Laboratory. Commercial (carcasses would now be in Standard grade and, therefore, are called Standard in this report) loins were aged 9 days; Good, 11; Choice, 13; and Prime, 17 at 38° F. This differential aging was considered to approximate commercial practice. The short loins were fabricated to loin backs from which ¾-inch steaks were cut. Steaks were identified by the respondents by the presence or absence of an aluminum ring around the bone.

TABLE 1--ORDER OF TESTING COLUMBIA PILOT PANEL

Test No.		Grade Weight* Ring	Grade Weight* No–Ring
1	11 April, 1955	Ch. Lt.	Ch. Hv.
2	14 April	Std. Md.	Ch. Md.
3	18 April	Std. Md.	Ch. Lt.
4	21 April	Ch. Lt.	Std. Md.
5	25 April	Pr. Md.	Std. Md.
6	28 April	Ch. Hv.	Std. Md.
7	2 May	Pr. Md.	Gd. Lt.
8	5 May	Gd. Lt.	Pr. Md.
9	9 May	Std. Md.	Ch. Hv.
10	12 May	Ch. Hv.	Ch. Lt.
11	16 May	Ch. Md.	Std. Md.
12	19 May	Std. Md.	Pr. Md.

*All carcasses were from lower third of grade and from weights groups as follows: Hv., 720 pounds; Md., 580; Lt., 470 (Choice) and 380 (Good). Only steers and heifers appearing to be less than 36 months old were selected.

A preference schedule was delivered with every pair of steaks and was picked up at the next delivery. This schedule was on a regular 27-column, marked sense

IBM card and was completed by the respondent with an electrographic pencil.

During two pretests, respondents learned to use the rating scale and the IBM cards. Respondents were asked to cook all the steaks by a single, preferred method and to a single, preferred degree of doneness.

The fat grades were preferred by more people than the lean grades (Table 2). The greatest popularity of a fat grade in any replicate was 55 preferences for Prime to 7 for Standard and 20 no preferences. However, on the first replicate of that comparison, only 32 preferred Prime while 26 preferred Standard and 24 had no preferences.

TABLE 2--PREFERENCES OF COLUMBIA PILOT PANEL

Comparisons:	Pr. Md. Gd. Lt.		Pr. Md. Std. Md.		Ch. Hv. Std. Md.		Ch. Md. Std. Md.		Ch. Lt. Std. Md.		Ch. Hv. Ch. Lt.	
Test Numbers:	7 & 8		5 & 12		6 & 9		2 & 11		3 & 4		1 & 10	
Preference for first grade	45	41	32	55	41	55	30	29	39	46	39	31
Preference for second grade	20	19	26	7	16	12	31	19	25	22	22	21
No Choice	13	20	24	20	22	15	14	29	16	14	21	30
Totals	78	80	82	82	79	82	75	77	80	82	82	82

Table 3 shows the proportion of consistent preferences for a fat grade was usually one-third or less. The large number of inconsistencies indicates either guesses because of an inability of many consumers to discriminate or shifts in preferences between replicates. Possibly, small differences existed in the product between replicates, but these were minimized by obtaining replicate steaks from the same carcass and the same relative position on the loins.

TABLE 3--PERCENTAGE OF SIMPLE PREFERENCES AND INCONSISTENT ACTIONS, COLUMBIA PILOT PANEL

Action Alternatives	Grades Compared					
	Ch. Md.- Std. Md.	Ch. Lt.- Std. Md.	Ch. Hv.- Std. Md.	Ch. Hv.- Ch. Lt.	Pr. Md.- Gd. Lt.	Pr. Md.- Std. Md.
1. Consistent Pref. for First Grade	12.00	31.70	37.98	18.29	34.21	24.39
2. Consistent Pref. for Second Grade	12.00	8.55	3.79	9.76	5.26	2.44
3. Pref. once & No. Pref. once	40.00	24.39	24.06	45.13	26.32	43.90
4. Reversed Pref.	28.00	29.27	22.78	18.29	26.32	24.39
5. Consistent No Preference	8.00	6.09	11.39	8.53	7.89	4.88
	100	100	100	100	100	100
	N(76)	N(82)	N(79)	N(82)	N(78)	N(82)

The odd sample in the trio was successfully chosen by 54 respondents in the first Prime-Good comparison, and 41 preferred Prime. In the second comparison 48 of the 52 successful respondents preferred Prime over Good. Moreover, 41 respondents consistently preferred Prime over Good for the two tests while only 3 consistently preferred Good over Prime.

It is difficult to determine the causes of inconsistent preferences. Some individuals were consistent much more often than others (Table 4). However, a large proportion of the group of respondents with a high number of inconsistencies tested the same group of loins. It is possible that these loins were more alike than the loins tested by the more consistent respondents. Only one person expressed consistent preferences on both replicates of all six comparisons.

TABLE 4--FREQUENCY DISTRIBUTION OF CONSISTENT PREFERENCES, COLUMBIA PILOT PANEL

Number of Times Consistent	Number of Respondents
0	15
1	16
2	23
3	17
4	10
5	0
6	1
	82

Steaks were rated individually on a 4-point-descriptive scale (Table 5). The fatter the grade the better its average hedonic score. However, grade and weight differences in scores were quite small. Mean ratings were 3.99, 3.70, and 3.90 for Choice Heavy, Choice Medium, and Choice Light, respectively.

TABLE 5--HEDONIC RATING OF FEDERAL GRADES, COLUMBIA PILOT PANEL, DUO TESTS

Hedonic Rating	Prime	Choice	Good	Standard
(2)[a] Poor	7	38	15	94
(3) Fair	59	187	46	186
(4) Good	123	267	69	241
(5) Very Good	135	151	32	121
N	324	643	162	642
Mean Rating	4.187	3.826	3.719	3.585
Standard Deviation	.8053	.9564	.8820	.9613
Hedonic Differential	(.361)	(.107)	(.134)	

[a] IBM row numbers. The larger the number the better the rating.

Preference responses of husband and wife were different about one-third of the time. One-fourth of the couples were different only 1 or 2 times out of a possible 12 in the duo tests, while three-fourths were different more often. This lack of independence presumably resulted from the consumption of homogeneous products—that is, identical products cooked in much the same way—and family discussion while deciding preferences. While such discussion was discouraged, it undoubtedly occurred. Preference satisfaction becomes a rather complicated problem when the preferences of husband and wife differ.

Respondents were given the alternatives of marking a preference or a "no-

choice" answer. Seven persons marked "no-choice" on one-half or more of the tests, while one person marked it on three-fourths of the tests. On the average, the "no-choice" answer was used about one-fourth of the time. It was decided to eliminate the "no-choice" blank in the next preference study to encourage consumers to express a preference.

Several tentative conclusions were drawn from this pilot study. Among the more important were the following:

1. A high degree of cooperation can be obtained for several weeks from a randomly drawn sample of households.

2. Careful supervision of the panel is essential to keep the test moving, and to prevent household accumulation of samples and careless completion of schedules.

3. The marked sense schedule card was workable but permitted only a very abbreviated schedule.

4. The trio test is probably solved more by visual clues than eating ones as long as a conventional cut like bone-in loin steaks is used.

5. Absence of an adequate method of predicting inter-animal acceptability differences indicates that certain replications in consumer studies must be from the same carcass.

6. For any given grade comparison one-half or more of the respondents did not consistently prefer one grade over another.

7. Most consistent preferences were for the fatter grades.

8. Mean hedonic ratings by grades were quite similar. Even Standard grade loins appeared to be fairly acceptable.

ST. LOUIS EATING PREFERENCE PANEL

Experimental Procedure

The panel was composed of 266 households randomly selected in St. Louis City and County. Thirty-eight tracts were sampled, and a serial sample of 7 households was selected within each tract. Considerable care was taken to insure an equal probability of selection of every household in the population. However, to recruit the panel in time to meet a pre-determined delivery schedule, only one call-back was made on not-at-homes, and occasionally no call-back was made. Therefore, there is a smaller proportion of working wives in the sample than in the population. Since the preference results appear to vary so little with population characteristics, preferences were probably biased very little by this sampling technique. However, some of the consumption data probably are somewhat biased. Two adults in each household prepared and ate a total of 6 pairs of loin steaks, rated them on an acceptability scale, and expressed preferences. These included 2 replicates of these grade comparisons: $Commercial_0$*-Choice; $Choice_1$-$Choice_2$; and Prime-Good. Loins were from carcasses in the middle third

*All grades consisted of younger cattle. The Commercial grade cattle would presently be graded Standard, and are called Standard in the discussion following.

of the grade as determined by a federal grader on ribbed-down carcasses. A total of 126 pairs of short loins were used. The experiment was conducted in September and October, 1955. The details of experimental procedure are much more fully described in Research Bulletin 651.[5]

Grade Preferences

Grade Preferences by Replicates: Panel members revealed a definite preference for the fatter grades. In the Standard-Choice$_0$ comparison, 81 percent of the men and 83 percent of the women preferred the Choice. Seventy-two percent of the men and 74 percent of the women preferred Prime in the Good-Prime comparison (Table 6).

TABLE 6--PERCENTAGES PREFERRING, NOT PREFERRING AND EXPRESSING NO PREFERENCE IN EACH REPLICATE

Total Rep. 1[a]	Grade	Preferring Rep. 1 Percent	Rep. 2 Percent	Not Preferring Rep. 1 Percent	Rep. 2 Percent	No Preference[b] Rep. 1 Percent	Rep. 2 Percent	Total Rep. 2[a]
	Men:							
244	Standard	17.2	26.8	80.7	65.9	2.1	7.3	246
248	Choice$_0$	80.7	67.5	16.9	25.1	2.4	7.4	243
244	Good	23.8	30.2	70.9	62.0	5.3	7.8	245
251	Prime	71.7	63.7	23.1	28.6	5.2	7.8	245
239	Choice$_1$	46.5	48.9	45.6	40.9	7.9	10.2	235
236	Choice$_2$	46.2	42.6	45.8	47.3	8.0	10.1	237
	Women:							
243	Standard	15.2	27.5	82.7	67.2	2.1	5.3	244
248	Choice$_0$	82.7	68.5	14.9	26.1	2.4	5.4	241
244	Good	20.9	32.7	73.4	62.4	5.7	4.9	245
251	Prime	74.1	64.1	20.3	31.0	5.6	4.9	245
239	Choice$_1$	46.4	42.1	46.4	47.2	7.1	10.7	233
238	Choice$_2$	46.2	48.7	46.6	40.7	7.2	10.6	236

[a]A number of panel members failed to complete the rating and preference sections of the schedule. Where either one or both were left blank, those schedules were removed from this analysis.

[b]These no-preferences were written in even though there was not a "no-choice" blank on the schedule.

The proportion preferring the fatter grade declined and the number preferring the leaner grade increased in the second replicate of each comparison. Approximately 68 percent of the men and women indicated a preference for the Choice$_0$ grade over Standard in the second replicate. Similarly, there was a decrease in the number preferring Prime in the second replicate with about 64 percent of men and women registering a preference for it. The proportion indicating no-preference among the two grades also increased in each comparison in the second replicate (Figure 1).

It could not be determined conclusively whether the shift in preference from the first to the second replicate represented a re-evaluation of the relative merits of the grades by some persons. Only 18 men and 16 women preferred Standard

Fig. 1—Percentage of Preferences of Men for Each Grade by Replicates.
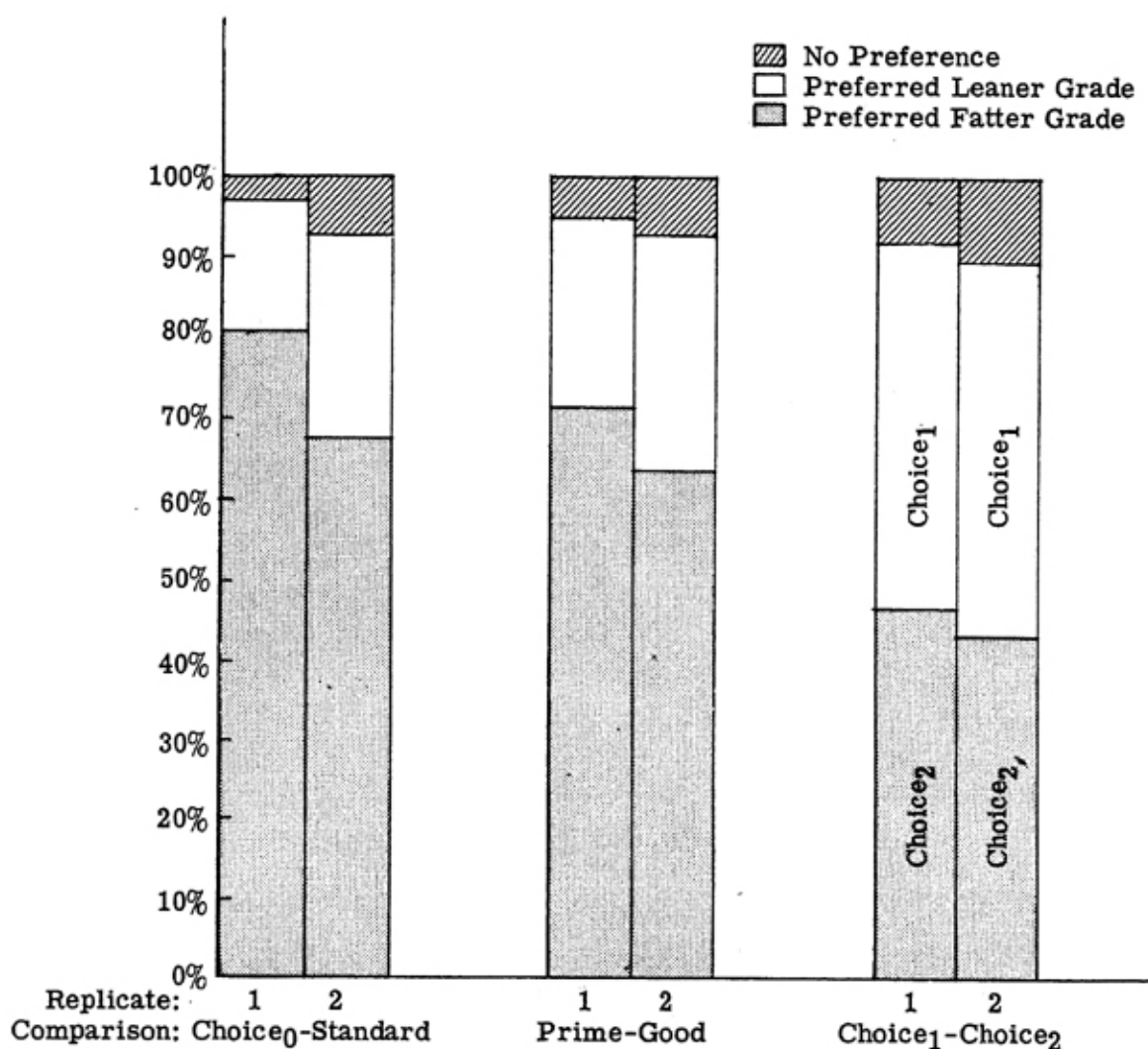
over Choice and 17 men and 20 women preferred Good over Prime in both replicates. So the largest proportion of the gain in preferences in the second replicate is represented by a shift of preferences of those persons who preferred the fatter grade in the first replicate. After some panel members had rated several other comparisons, the leaner grades apparently did not appear as inferior in eating characteristics in the second replicate as they had in the first replicate.

This problem of stability of preferences was recognized in the study design but resources did not permit more than two replications. Possibly, a larger number of replications of the same comparisons would have indicated the nature of shifts in preferences. Previous experience of panel members may have influenced their preferences in the first replicate, whereas their experience on the panel through time may have modified their preferences in the second replicate.

The identical grade comparison followed a logical pattern. The distribution of preferences was similar to one expected by chance and the number of those

indicating no preference was considerably higher. Slightly more than 10 percent of the panel members indicated no preference (Table 6). This does not imply that there were no individual differences in the carcasses but that on the average the carcasses were quite similar. There were significant differences beween four pairs of carcasses but because of the random sorting into "grades" one group was not preferred more often than the other. Differences among the $Choice_1$-$Choice_2$ loins were shown in the analysis of separate loin comparison ratings and in their respective shear values.

Consistency of Preferences: Further study was made of preferences of those persons in the panel who preferred the same grade in the comparison in both replicates. For purposes of this analysis those switching preferences between replicates in the comparison are termed inconsistent.

Switches in expressed preferences may reflect: (1) changes in basic consumer preference concerning the test pair; (2) changes in the nature of the test pair; and (3) the chance result of consumer guessing caused by lack of preference for either product. While experimental controls were designed to keep the meat constant, variations were possible in the preparation and consumption environment between replicates. It has often been assumed that switches are caused by guessing. Unfortunately, there is insufficient evidence to indicate the relative importance of the various possible causes of switches in preferences.

Approximately 7 percent of the panel members preferred the Standard and Good grades in both replicates in their respective comparisons (Table 7). The proportions of those preferring the higher grades in these comparisons were markedly different. Fifty-seven percent preferred $Choice_0$ and 47 percent, Prime. The proportions of inconsistencies or switched preferences likewise were different

TABLE 7--NUMBER AND PERCENTAGE EITHER PREFERRING A GRADE OR SHOWING INCONSISTENCY IN BOTH REPLICATES OF THE COMPARISON[a]

Comparison	Men (Number)	Women (Number)	Total (Number)	Total (Percent)	Chance Percentage Distribution[b]
Standard	18	16	34	6.85	25.0
$Choice_0$	140	144	284	57.26	25.0
Inconsistent	90	88	178	35.89	50.0
	248	248	496	----	
Good	17	20	37	7.37	25.0
Prime	117	121	238	47.41	25.0
Inconsistent	117	110	227	45.22	50.0
	251	251	502	----	
$Choice_1$	53	62	115	23.96	25.0
$Choice_2$	60	54	114	23.95	25.0
Inconsistent	127	124	251	52.09	50.0
	240	240	480	----	

[a]Those who switched preferences from the first to the second replicate are called inconsistent.

[b]Expected percentage probability distribution of preferences if compared items were identical.

in the two comparisons. Nearly 36 percent were inconsistent or switched preferences in the Standard-Choice$_0$ as contrasted to 45 percent in the Good-Prime comparison. The fact that fewer inconsistent preferences appear in the Standard-Choice$_0$ than in the Good-Prime comparison is evidence that the difference in eating characteristics between Good and Prime is less than that between Standard-Choice$_0$.

In double replicate comparisons where preference expression is forced, the expected theoretical distribution of preferences would be 25 percent preferring one grade, 25 percent preferring the other grade, and 50 percent inconsistent (switched preferences). This would be expected only when the compared grades were homogeneous and had identical mean hedonic ratings. If homogeneous grades with different means were compared, the distribution of preferences would depart from 25 : 25 : 50, depending on which of the two grades was preferred and the degree of difference in mean acceptability. The expected proportion of inconsistencies would be much less than 50 percent if the difference between the two homogeneous grades (with different means) was substantial. When two grades, each having considerable heterogeneity are compared, little can be said about the expected distribution of preferences.

In the identical grade comparison, the distribution of preferences between Choice$_1$ and Choice$_2$ was similar to that expected by chance when preferences are expressed between homogeneous groups with identical means (Table 7). Panel members probably "had to look" for differences between the steaks in this comparison to a greater degree. Nonetheless, there were differences which were reflected in the ratings of the steaks of individual loins.

Only a limited amount of disagreement in preferences was typically found when consumers were evaluating a homogeneous product—i.e., a carcass. As Table 8 shows, whenever several persons consistently preferred a carcass, there was seldom more than one person consistently not preferring that carcass. Usually several consumers preferred a carcass consistently while the other consumers were inconsistent, preferring it one time but not the other. There was near unanimity of not preferring several carcasses such as G, U, D, and T of the Standard grade, and E of the Good grade. The average acceptance ratings of these carcasses were quite poor. The differences in both preferences and ratings are evidence of the heterogeneity within grades. Carcasses B, F, V, R, and A of the Standard grade were comparable to the typical Choice$_1$ grade in acceptability and were probably better than several of the Choice$_1$ carcasses. Five Choice$_0$ carcasses were preferred consistently by nine or more male respondents but no Prime carcasses were preferred consistently by that many men.

Preferences and Ratings: Preferences were, of course, related to acceptability ratings. Those preferring a particular grade generally rated it fairly high. The mean rating of all consistently preferred grades was 2.39 while the mean rating of all non-preferred grades was the poorer score of 4.06 (Table 9). The mean

TABLE 8--NUMBER OF MEN PREFERRING AND NUMBER INCONSISTENT COMPARED TO AN ARRAY OF CARCASS MEAN RATINGS OF A GRADE IN THE COMPARISON

| | Standard - Choice$_0$ | | | | | Good - Prime | | | | | Choice$_1$ - Choice$_2$ | | |
| | | Number | | | | | Number | | | | | Number | |
Carcass	Mean Rating	Preferring Std.	Preferring Ch.$_0$	Inconsistent	Carcass	Mean Rating	Preferring Gd.	Preferring Pr.	Inconsistent	Carcass	Mean Rating	Preferring Ch.$_1$	Preferring Ch.$_2$	Inconsistent
B	2.65	5*		6	T	2.59	3	3	7	L	2.27	10**	1	0
F	3.08	4	1	6	C	2.65	2		6	J	2.52	4		6
V	3.11		5	9	R	3.04	3	4	5	M	2.57	6*		6
R	3.48	3	2	7	G	3.17	1	4	7	S	2.75	3		7
A	3.71	2	4	6	P	3.33	1	5*	6	R	2.81	1	4	7
C	4.00		7**	3	H	3.35		6*	5	G	2.86	3	2	7
I	4.12		5*	6	B	3.38	1	5*	6	A	2.88	3	3	6
H	4.14	1	6*	3	L	3.38	1	4	5	H	2.91	2	2	7
J	4.39	1	5*	4	F	3.54		4	7	F	2.92	3		8
P	4.64		8**	5	A	3.58		7**	4	N	3.00	4	2	5
E	4.65	1	7*	4	V	3.60		7*	6	W	3.11	2	4	6
M	4.65		7**	3	N	3.61	1	6*	5	C	3.14	2	1	6
S	4.89		11**	3	I	3.63	1	7*	4	D	3.17	6*		5
W	4.96		8**	4	D	3.67		5	7	E	3.17	4	1	5
N	4.96		6*	6	W	3.93	1	8**	5	V	3.35	1	5	7
G	5.04		10**	1	J	3.96	1	4	6	K	3.38	1	5*	5
U	5.33		10**	2	K	4.04	1	6*	5	P	3.39	2	5	6
K	5.52	1	8**	3	S	4.08		7**	5	I	3.50		3	7
L	5.61		7**	4	U	4.22		8**	4	U	3.54	2	1	10
D	5.79		9**	2	E	4.77		8**	2	B	3.71	1	3	7
T	6.74		12**	1	M	4.79		6*	6	T	3.74		10**	4

*.05 level[a]

**.01 level

[a] Significance of discrimination was computed on the basis of the probability of x successes in N trials where P = 1/4 = probability of consistent preference by a person guessing at random.

TABLE 9--MEAN RATINGS OF STEAKS BY GRADE OF THOSE CONSISTENTLY
PREFERRING OR NOT PREFERRING AND THOSE INCONSISTENT
BOTH REPLICATES COMBINED

Grade	Mean Ratings of Those Preferring	Mean Ratings of Those not Preferring	Mean Ratings of Those Inconsistent	Weighted Mean Rating
Men:				
Standard	2.58	5.38	3.61	4.54
$Choice_0$	2.43	4.02	3.11	2.84
Good	2.32	4.26	3.22	3.65
Prime	2.28	3.44	3.03	2.71
$Choice_1$	2.44	3.91	3.10	3.12
$Choice_2$	2.18	3.96	3.16	3.14
Women:				
Standard	2.80	5.50	3.57	4.63
$Choice_0$	2.45	3.68	3.04	2.75
Good	2.34	4.04	3.16	3.52
Prime	2.19	3.02	2.90	2.57
$Choice_1$	2.49	3.68	3.11	3.09
$Choice_2$	2.22	3.86	3.02	3.05
Overall Unweighted Mean	2.39	4.06	3.17	

ratings of those women who consistently preferred Prime was only 0.83 better than the mean of those women not preferring Prime. Thus, there was probably relatively little difference in the consumer attitudes toward Prime between the women preferring and those not preferring that grade. However, those few men who consistently preferred Standard grade rated it much higher than those not preferring it (Figure 2). As noted earlier, these differences in consumer attitudes were probably largely caused by grade heterogeneity. Nine of the 18 men who consistently preferred Standard tasted one or the other of the two highest rated Standard carcasses (Table 8).

Differences in preferences between men and women were insignificant. Though they were asked to make their choices separately, we cannot presume that their ratings and choices were entirely independent.

Despite the preponderant shift in preferences noted above, the mean ratings of the grades shifted only slightly among those preferring a grade. In only one instance was there a significant difference between the mean ratings of the two replicates. This was in the case of the Choice grade in Standard-$Choice_0$ comparison which was rated significantly lower in the second replicate (Table 10). The mean ratings of the grades by those not preferring or those having no preference for the particular grade were not significantly different between replicates. As expected, the mean ratings of those indicating no preference generally were higher for all grades than the ratings for those not preferring them. The mean ratings by

Fig. 2—Mean Ratings of Grades by Those Men Consistently Preferring or Not Preferring That Grade.
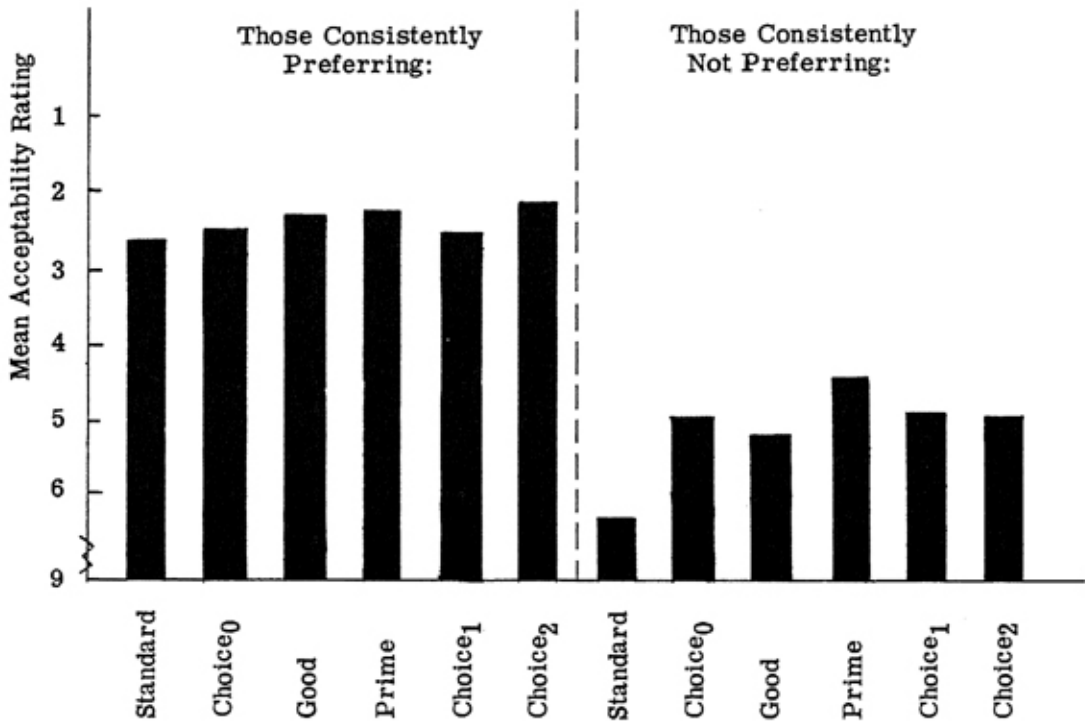

TABLE 10--MEAN RATINGS OF GRADES OF STEAKS OF THOSE
PREFERRING, NOT PREFERRING AND THOSE INDICATING
NO PREFERENCE IN EACH REPLICATE

Grade	Those Preferring Mean Rating Replicate 1	Replicate 2	Those Not Preferring Mean Rating Replicate 1	Replicate 2	No Preference Mean Rating Replicate 1	Replicate 2
Men:						
Standard	2.40	2.43	5.27	5.14	4.60	3.72
$Choice_0$	2.18**	2.68**	4.04	4.16	4.00	3.66
Good	2.34	2.52	4.24	4.20	3.00	2.52
Prime	2.28	2.31	3.79	3.87	2.38	2.57
$Choice_1$	2.50	2.29	4.04	3.84	3.36	2.54
$Choice_2$	2.34	2.41	4.12	3.69	3.36	2.54
Women:						
Standard	2.35	2.40	5.39	5.26	3.40	3.46
$Choice_0$	2.13**	2.69**	4.10	4.00	2.16	3.46
Good	2.31	2.40	4.06	4.09	2.14	2.08
Prime	2.11	2.24	3.88	3.64	2.14	2.08
$Choice_1$	2.37	2.37	3.96	3.78	2.41	2.52
$Choice_2$	2.30	2.31	4.05	3.90	2.41	2.52

**Difference between replicate means significant at .01 level.

those having no preference were substantially the same for all grades except Standard.

Mean ratings of men preferring a particular grade in the first replicate are interesting; they ranged from 2.18 to 2.50 for all grades. The difference among the mean ratings between grades in this group was not significant at the 1 percent level. This suggests that the men in this study who preferred a particular grade liked the steaks equally as well in rating scale terms as those who preferred the other grades. The same general relationships held for women members of the panel.

The data would suggest that for some segments of the population certain leaner grade loins were preferred (at equal prices) in terms of relative eating characteristics. The mean ratings suggest that these persons liked them as well as those who preferred the fatter grade loins. Although interpersonal comparisons of preferences cannot be made, the fact that there were no differences in the mean ratings among those preferring indicates that for some people some leaner grade loins were quite satisfactory.

Inspection of the frequency of the ratings given for the preferred grade reveals a positively skewed frequency distribution (Figure 3). The distribution of ratings for each grade is quite similar. Forty percent or more of the ratings for each grade were the modal rating 2.

The frequency distribution of the ratings of those who did not prefer the grade also is skewed but is less peaked. The distribution for Prime is the most peaked while the distribution of ratings of the other grades is flatter. The modal rating for Prime and Good was 3 and for Choice and Standard was 4. It appears that some persons rated the non-preferred grade down more severely than others. About 43 percent of the ratings of Standard were 6 or lower; yet, more than 20 percent were rated 3 or higher. After having rated one grade superior and having expressed a choice, some persons were apparently unsure as to what level the non-preferred grade might be rated in relation to the preferred. On the other hand, the greater dispersion of ratings of the non-preferred grade reflects in part the differences in attitudes of panel members toward the particular pairs of loins of the two grades. In some cases the difference between the two grades was small but was sufficient for them to express consistent preferences over both replicates. For others the difference was large and ratings of the non-preferred grade consequently were placed low on the scale.

A comparison of the mean ratings of respondents consistently preferring or not preferring a grade in both replicates reveals much the same characteristics as reported above for single replicate preferences (Table 11): That is, those preferring a grade gave higher hedonic ratings, while those not preferring the grade gave the lowest ratings. Those respondents termed inconsistent gave ratings that fall in between the ratings of those preferring and those not preferring. Thus, the ratings on the first replicate were a fair predictor of consistency or inconsistency of preference. The closer the ratings were on a pair in the first replicate,

Fig. 3—Frequency Distribution of Ratings of Those Preferring and Those Not Preferring Grade.
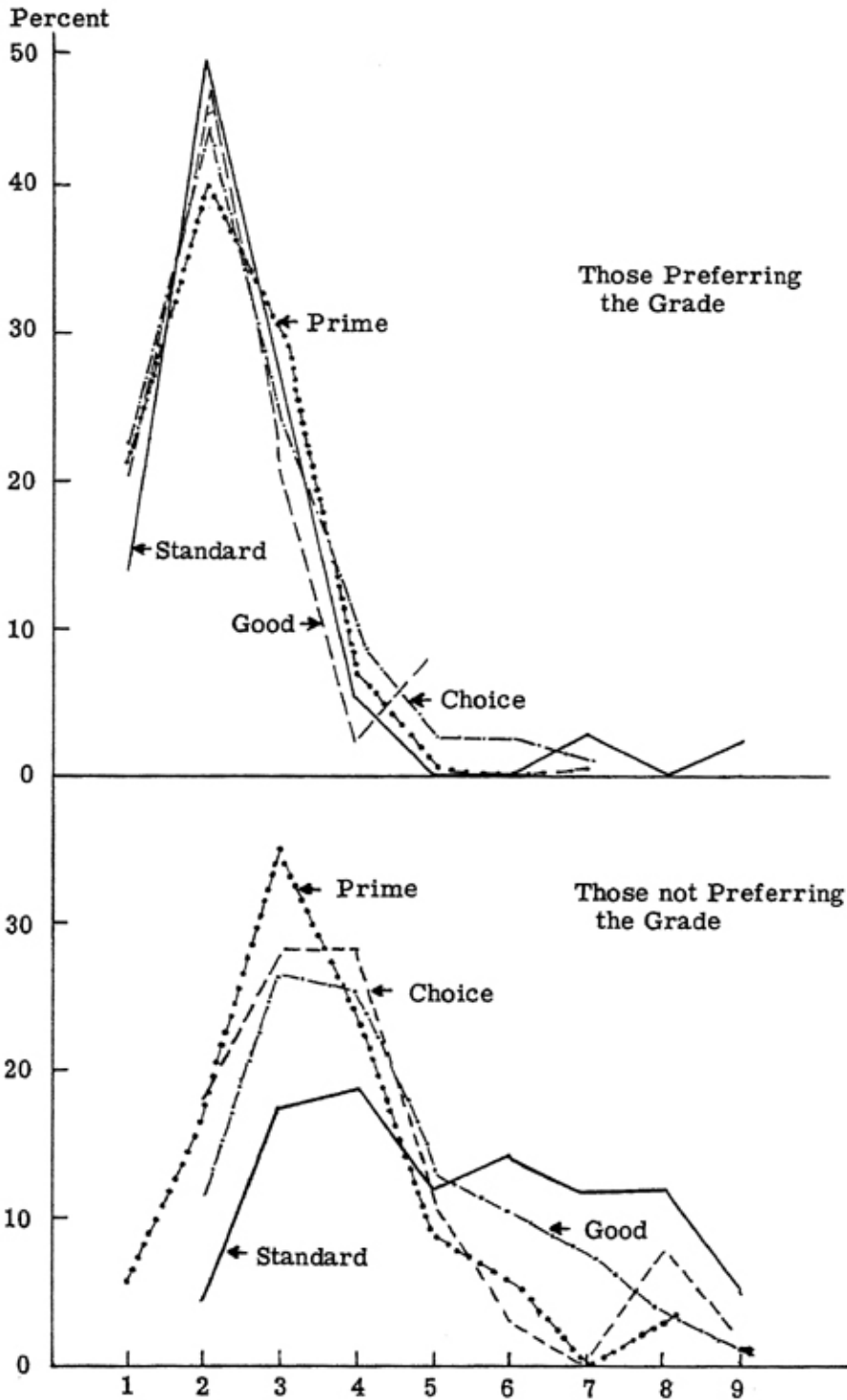
TABLE 11--MEAN RATINGS BY REPLICATES OF GRADES OF STEAKS
BY THOSE CONSISTENTLY PREFERRING OR NOT PREFERRING
AND THOSE INCONSISTENT BOTH REPLICATES

| | | Mean Ratings | | | | | | | |
| | | (1) Those Preferring | | | (2) Those Not Preferring | | | (3) Those Inconsistent | |
Grade	N	Rep. 1	Rep. 2	N	Rep. 1	Rep. 2	N	Rep. 1	Rep. 2
Men:									
Standard	18	2.77	2.38	140	5.45	5.32	90	4.09**	3.14**
$Choice_0$	140	2.19**	2.67**	18	3.94	4.11	90	2.54**	3.67**
Good	17	2.17	2.47	117	4.28	4.25	117	3.40	3.05
Prime	117	2.24	2.32	17	3.47	3.41	117	2.90	3.15
$Choice_1$	53	2.58	2.30	60	4.00	3.82	127	3.30**	2.90**
$Choice_2$	60	2.21	2.15	53	4.05	3.86	127	3.30	3.02
Women:									
Standard	18	3.11	2.50	137	5.68	5.42	88	4.01**	3.13**
$Choice_0$	137	2.15**	2.75**	18	3.61	3.76	88	2.62**	3.45**
Good	17	2.52	2.17	117	4.00	4.08	113	3.32	2.99
Prime	117	2.09	2.29	17	2.94	3.11	117	2.79	3.00
$Choice_1$	60	2.42	2.56	53	3.67	3.69	127	3.20	3.01
$Choice_2$	53	2.19	2.24	60	3.88	3.85	127	3.14	2.89

**Difference between replicate means significant at .01 level.

the more likely the pair would be switched on the second replicate. This same relationship was observed in the pilot Columbia panel.

The replicate mean ratings of those preferring $Choice_0$ were significantly different for both men and women. Little significance can be attached to the shift in mean ratings in the inconsistent group as this classification includes both first and second replicate preferences.

When the mean ratings of both replicates are combined, the general level and uniformity of the ratings of those preferring the grades is again impressive. The range in the ratings of this group was less for men than for women (Table 9). Those not preferring a particular grade tended to rate down the lower grades more severely than the higher grades.

The heterogeneity among carcasses within grades, particularly of the lower grades, is an important factor in the variation of level of ratings where two grades are compared. For a particular comparison the carcasses of each grade may be typical or atypical; that is, they may depart greatly from that generally expected of the grade. For example, in terms of eating characteristics, a Standard grade carcass may be similar to a Choice and, conversely, the Choice may be similar to the Standard. The goal in preference research is to reduce the variability and also to discover means of controlling the product characteristics so that more meaningful preference determinations can be made.

The carcasses (loin pairs) of one grade were randomly paired with the carcasses of the other grade in each of the experimental comparisons. An array of the mean ratings of the Standard, Good and $Choice_1$ carcasses is shown in Table 8. The B pair of loins was rated the most acceptable of all Standard loins. There

were 5 persons who consistently preferred it and 6 who were inconsistent. There was a general tendency for the number preferring the loins to be highly and positively associated with the hedonic mean ratings. There was an inverse relation of the number not preferring the loins to the hedonic mean ratings. The simple coefficient of correlation of the mean acceptance difference between a pair of loins and the number of inconsistent preferences was –0.80. Moreover, the higher number of inconsistencies appeared to be associated with the higher (more acceptable) mean ratings. This general pattern apparently occurred in the case of Good in the Good-Prime and of $Choice_1$ in the $Choice_1$-$Choice_2$ comparisons, though the associations were less striking.

Referring again to Standard loin pair B, it must have been quite similar in eating characteristics to the $Choice_0$ loin pair with which it was compared. Six persons apparently could not make up their minds about the relative merits of steaks from the two non-adjoining grades. The same inference probably could be drawn from the F pair of Standard and $Choice_0$ loins. To a lesser degree the same may be said of the T and of the C pairs of Good grade loins and the Prime loins compared with them. On the other hand, the Standard loins (T) probably were quite different from the $Choice_0$ loins compared with them. No one expressed a preference for the Standard steaks of this pair of loins and only one person was undecided. The shear value difference between the T pair of loins was the greatest of any pair in this comparison (cf. Table 12).

TABLE 12--DIFFERENCE IN MEAN RATINGS BY MEN AND DIFFERENCE IN SHEAR VALUE OF LOIN PAIRS

Loin Pair	Standard-$Choice_0$ Comparison		Good-Prime Comparison		$Choice_1$-$Choice_2$ Comparison	
	Difference in Mean Rating[a]	Difference in Shear Value	Difference in Mean Rating[a]	Difference in Shear Value	Difference in Mean Rating[a]	Difference in Shear Value
A	0.38	6.3	1.50	7.1	0.13	1.2
B	-1.00	1.1	0.71	11.8	0.88	8.0
C	1.55	12.0	-0.31	0.0	0.14	1.9
D	3.17	14.8	0.84	3.5	-1.37	-4.4
E	1.43	4.3	1.82	5.5	-0.54	3.6
F	-0.40	1.6	0.54	3.8	0.01	-1.4
G	2.58	8.1	0.38	-1.7	-0.69	-2.3
H	1.38	2.5	1.00	3.9	0.00	0.6
I	1.12	10.9	0.84	4.5	0.21	1.6
J	1.48	5.7	0.83	15.9	-0.61	-2.2
K	2.78	7.7	1.54	9.5	0.84	5.3
L	2.61	8.8	0.59	-2.9	-1.91	-6.4
M	2.22	9.5	1.62	5.8	-0.82	-9.7
N	1.88	8.7	1.44	13.2	-0.48	-6.2
P	1.68	10.0	0.33	3.7	0.75	5.6
R	-0.41	-0.1	0.12	8.5	0.22	-0.5
S	2.03	11.2	1.40	7.3	-0.14	-3.4
T	4.30	26.2	0.52	2.1	1.22	5.1
U	3.18	6.3	1.33	9.3	0.19	-1.0
V	0.61	0.3	1.04	1.1	0.58	6.3
W	2.22	4.8	1.08	2.5	0.04	3.3
Average	1.66	7.65	0.9	5.9	-1.35	3.8

[a]A negative difference in mean rating indicates that the first grade in the comparison had a mean rating superior to the second grade.

Selection of carcasses on the basis of federal grade standards alone provides insufficient control criteria of product. In addition, improved physical measurements are needed to assure uniformity of product samples for preference determinations. It is believed that the problem of product control maintenance has not been fully recognized in many preference studies.

Relation of Preferences to Shear Variation

The simple coefficient of correlation of the mean shear difference between a pair of loins and the number of inconsistencies in preferences was -0.54. The greater the shear difference the less the number of inconsistent preferences.

An inverse relation between the number of persons preferring a carcass and its shear measurement would appear logical. However, as indicated by Figure 4 this relation was extremely weak. This relation was much weaker than the relation of shear to acceptance ratings. (See Research Bulletin 651.)[5] Since preferences are a function of two loins, the relationship of the shear of one loin to preferences could be expected to be rather imprecise.

Relation of Preferences to Cooking Methods and Degree of Doneness

There was undoubtedly considerable variation in the cooked steaks in degree of doneness and in cooking methods. These variations may have affected the level of acceptability. Each housewife was asked to cook all steaks in her customary way. These cooking variations were crudely measured by a 4-way classification of methods—broil, pan-fry, braise, and other—and a 2-way classification of doneness—rather well-done (no red meat) and somewhat rare. Forty-six percent of the steaks were broiled and 47 percent were pan-fried. Seventy-two percent were cooked well-done and 24 percent were cooked rare while another 4 percent were cooked rare for one family member and well-done for the other. Consistent preferences for Prime were not related to method of cooking or degree of doneness. However, there were slightly more inconsistencies among those who fried and/or those who cooked well-done than among others.

Relation of Preferences to Socio-Economic Characteristics

Women aged 25 to 39 were slightly less favorable toward the fatter grades and slightly more favorable toward the leaner grades than other women. These same women were more often inconsistent in their preferences.

It was found earlier that income levels of the panel members were a factor in accounting for variation in the rating scores. An analysis of the shifts in the preferences as related to income levels suggests that certain income classes made greater shifts to the lower grade in the second replicate (Table 13). In the Standard-Choice$_0$ comparison the $4,000-$5,999 income class made the greatest shift to the Commercial grade. For example, while there was an average shift for men of 57 percent to the Standard grade, this particular income group

Fig. 4—Relationship of Number of Men Consistently Preferring the Carcass to Shear Values by Grades.
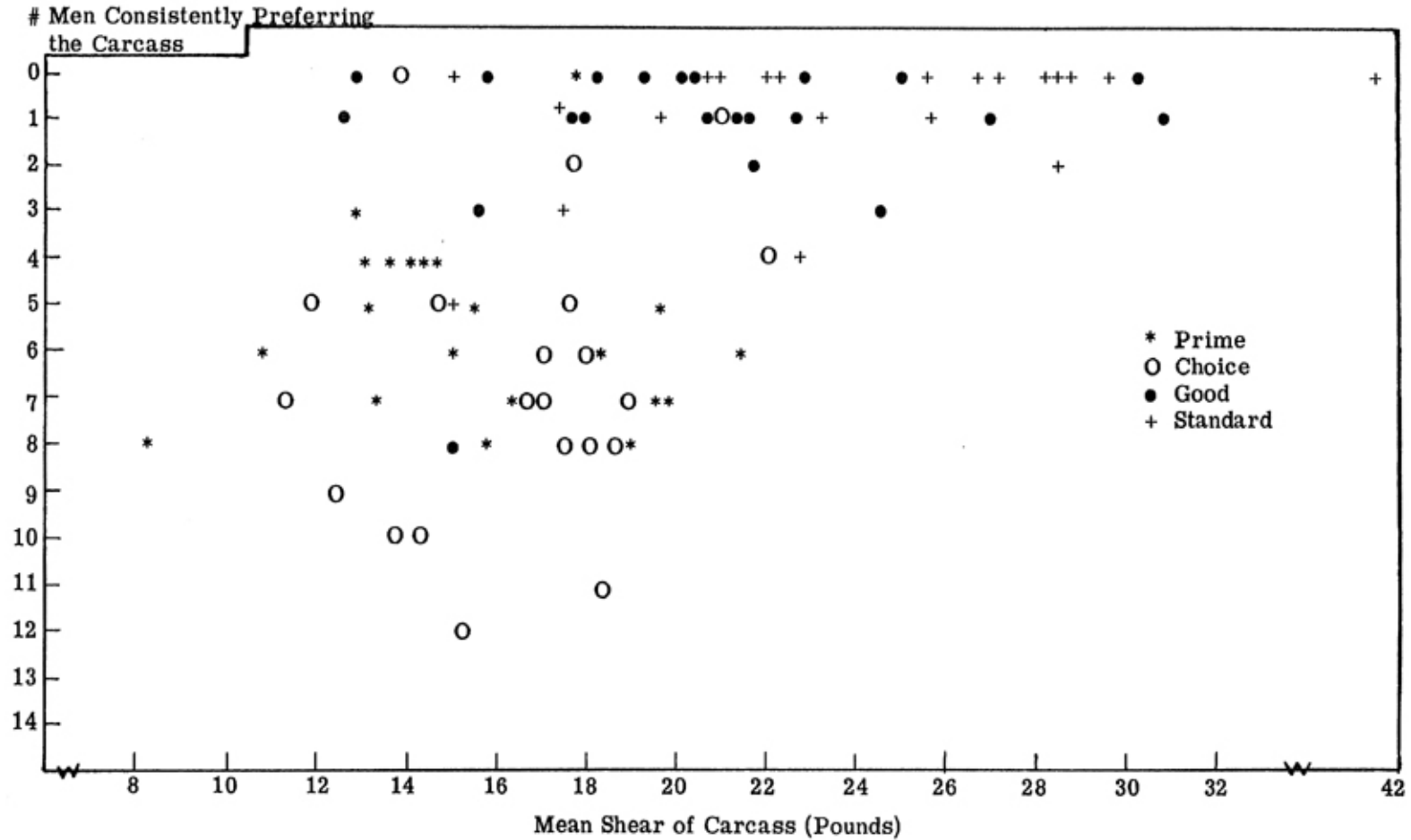

Men Consistently Preferring the Carcass

Mean Shear of Carcass (Pounds)

* Prime
O Choice
● Good
+ Standard

TABLE 13--PERCENTAGE SHIFT OF PREFERENCE FROM REPLICATE 1
TO REPLICATE 2 ACCORDING TO INCOME

Income Class	Those Preferring Standard Percentage	Choice Percentage	No Prefer-ence	Those Preferring Good Percentage	Prime Percentage	No Prefer-ence
Men:						
$2,500 - 3,999	- 22	+ 4	+ 50	+11	- 4	0
$4,000 - 5,999	+ 81	-23	+800	+16	- 8	+ 60
Over $6,000	+ 75	-19	+100	+63	-24	+100
Average Percent	+ 57	-18	+200	+28	-13	+ 54
Women:						
$2,500 - 3,999	+ 25	- 7	0	+50	-15	0
$4,000 - 5,999	+153	-23	+150	+44	-11	- 14
Over $6,000	+ 43	-20	+200	+87	-22	0
Average Percent	+ 84	-20	+150	+57	-15	- 7

shifted to the extent of 81 percent. There was an average shift of 84 percent for women but the women of this income group shifted to the extent of 153 percent.

Again in the Good-Prime comparison there was a differential income influence on the shifts from the first to the second replicate. While there was an average shift of 28 percent of the men in preference for the Good grade, the income class above $6,000 shifted 63 percent. The same phenomenon appeared among women panel members but was not quite as strong. There was no difference among income groups with respect to the number of times they indicated no preference among the grades in the particular comparison.

Relation of Preferences to Grade of Beef
Ordinarily Purchased

Most of the stores named by panel members as principal sources of beef were visited to learn the grade sold. Many stores handled more than one grade (Table 14). The proportion handling more than one grade is probably slightly over-estimated because several of the smaller stores, which probably handled only one grade, were not visited.

There appeared to be a slight relation of preference to grade customarily purchased. A slightly higher proportion of those who purchased Choice consistently preferred the fatter grades than of those who purchased Good or shopped at stores offering a leaner grade as well as Choice (Table 15 and Figure 5). The proportions are too similar and numbers are too small to justify any inferences to the population.

Relation of Preferences to Trio Discrimination

Six steaks from each of 84 loin pairs were used in trio tests by a laboratory panel. This was an attempt to obtain an independent measure of the sensory difference between these paired loins.

There was a positive association between the size of the difference in mean ratings of a pair of loins and the proportion of successful laboratory trios (See

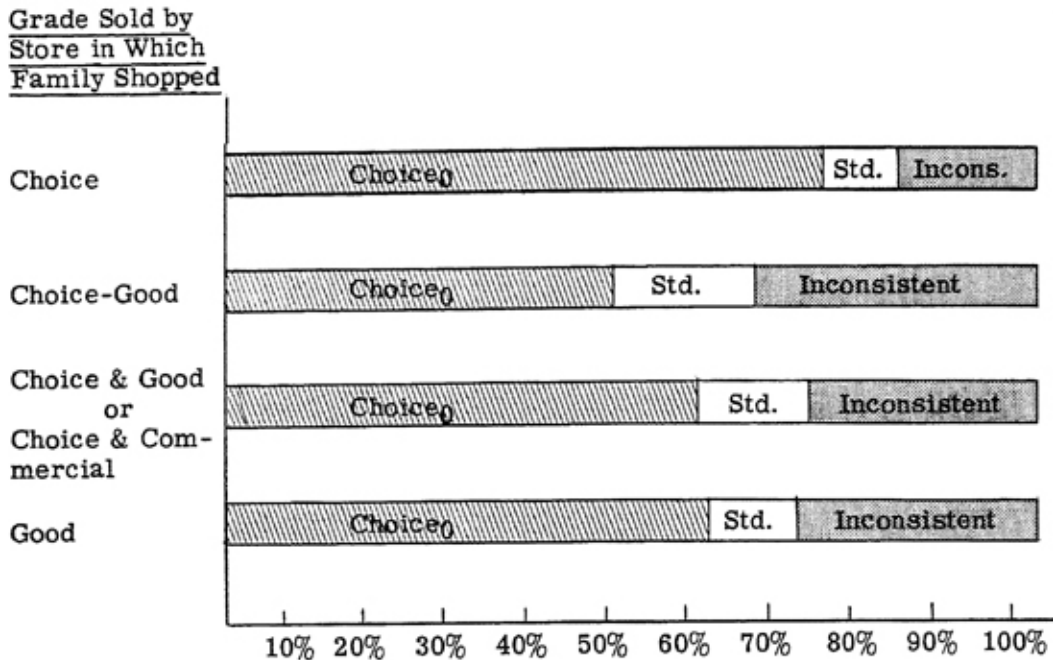**Fig. 5—Percentage Consistent Preferences and Inconsistent Preferences Choice$_0$-Standard Comparison.**

TABLE 14--BEEF GRADES AVAILABLE IN STORES IN WHICH
ST. LOUIS PANEL SHOPPED

Grades Sold[a]	No. of Different Stores	No. of Respondent Households Shopping There
Prime	1	1
Choice	31	56
Choice or Good[b]	16	17
Good	41	73
Commercial	1	2
Choice and Commercial	12	36
Good and Commercial	3	5
Choice and Good	9	24
Choice, Good, and Commercial	5	10
Prime, Choice, and Commercial	4	9
Prime, Choice, and Good	2	3
Prime, Choice, Good, and Commercial	1	4
Totals	126	240

[a]Generally, the stores selling more than one grade sold them separately and by grade label. Occasionally, the leaner grade was sold under a brand name rather than a grade label.

[b]A chain store which sold Choice and/or Good under its own single brand and not the two grades separately.

TABLE 15--RELATION OF GRADES PREFERRED TO GRADES PURCHASED
NUMBER OF MALE RESPONDENTS:

Grade Sold by Store in Which Family Shopped	(1) Consistent Preferences for:				Inconsistent Preferences	
	Choice	Standard	Prime	Good	Ch-Std	P-G
Choice	34	4	26	6	8	15
Choice-Good	17	6	13	5	13	14
Choice and Good Choice and Commercial	31	7	24	3	15	24
Good	38	7	34	2	19	29

Research Bulletin 651). There was a slight positive relation between the proportion of consistent preferences between two loins and the proportion of successful laboratory trios (Table 16).

Would laboratory discrimination tests have been a good predictor of which pairs of loins consumers could discriminate between? Table 17 shows that discrimination results of consumers and laboratory tasters were in agreement on 26 of 41 loin pairs. Both consumers and laboratory judges discriminated between 15 pairs; neither group discriminated between 11 pairs; 10 were discriminated between by consumers but not the judges; and 5 were discriminated between by the judges but not the consumers.

While the lack of better agreement is disappointing, there was a positive relationship. Laboratory discrimination tests appear to be a somewhat useful but not a wholly accurate predictor of consumer discrimination between small groups of loin steaks. It is interesting to note that consumer preferences more often showed significant discrimination than did laboratory trios. This phenomenon has been reported by others.[8] It would appear rather risky to infer consumer discrimination solely from laboratory judgments.

Evaluation of Preference Measurement

When this study was designed, the relative merits of the single-stimulus and the paired-comparison techniques were considered. It was assumed that the single stimulus was a slightly better technique for obtaining acceptance ratings (See Research Bulletin 651 for a discussion of this assumption). However, it was felt that the paired technique would give a better measure of consumer ability to discriminate. Acceptance means of two products may not be different, even though consumers discriminate between them, if consumers' preference patterns differ in a certain fashion. It has been argued previously that measurement of consumer discrimination is an integral part of preference research concerned with grades.[9] Therefore, it was decided to use the paired-comparison technique and to obtain preferences rather than relying solely on acceptance ratings.

Preferences were obtained twice. The probability of a preference being repeated was 1 out of 2 if the person was guessing. It has been reasoned by other writers that the number of guessers is equal to twice the number of inconsistencies. Thus, the estimated percentage of guessers would be 72 in the Commercial-Choice comparison, 90 in the Good-Prime, and 100 in the $Choice_1$-$Choice_2$ (Table 7). However, there is evidence that the inconsistencies did not

TABLE 16--COMPARISON OF PERCENTAGE SUCCESSFUL DISCRIMINATION OF HOUSEHOLD CONSUMER PANEL AND LABORATORY PANEL

| | Commercial-Choice | | | | Good-Prime | | | | Choice-Choice | | | |
| | Consumer Panel | | Laboratory Panel | | Consumer Panel | | Laboratory Panel | | Consumer Panel | | Laboratory Panel | |
	Actual[a]	Net[b]	Actual[c]	Net[d]	Actual[a]	Net[b]	Actual[c]	Net[d]	Actual[a]	Net[b]	Actual[c]	Net[d]
A	50.0	0	68.75**	53.6	63.64	27.3	56.25	34.9	50.0	0	86.67**	80.5
B	41.67	0	43.75	16.1	50.00	0	81.25**	72.4	36.36	0	43.75	16.1
C	70.00	40.0	75.00**	63.0	33.33	0	50.00	25.5	37.50	0	60.00*	40.5
D	81.82	63.6	93.75**	91.1	41.67	0	31.25	0	54.55	9.1	62.50**	44.2
E	72.73	45.5	43.75	16.1	80.00	60.0	56.25	34.9	50.00	0	68.75**	53.6
F	45.45	0	37.50	6.8	36.36	0	68.75**	53.6	27.27	0	37.50	6.8
G	90.91	81.8	93.75**	91.1	41.67	0	43.75	16.1	41.67	0	53.33	30.5
H	72.73	45.5	46.67	20.5	54.55	9.1	80.00**	70.5	40.00	0	40.00	10.5
I	45.45	0	73.33**	60.5	66.67	33.3	46.67	20.5	30.00	0	56.25	34.9
J	60.00	20.0	40.00	10.5	50.00	0			40.00	0	46.67	20.5
K	75.00	50.0	81.25**	72.4	58.33	16.7	73.33**	60.5	54.55	9.1	80.00**	70.5
L	70.00	40.0	86.67**	80.5	50.00	0	26.67	0	100.00	100.0	53.33	30.5
M	77.78	55.6	66.67**	50.5	50.00	0	66.67**	50.5	50.00	0	66.67**	50.5
N	50.00	0	66.67**	50.5	58.33	16.7	93.33**	90.5	45.45	0	53.33	30.5

**Significant at .01 level.

*Significant at .05 level.

[a]Percentage consistent preferences were of total consistent and inconsistent preferences.

[b]Using formula $C = 2(O-E)$ Where C = percent correct above chance; O = Observed percent correct; E = Expected percent correct.

[c]Percentage successful discriminations were of total trios.

[d]Using formula $C = 3/2(O-E)$

TABLE 17--THREE MEASURES OF DISCRIMINATION BETWEEN LOIN PAIRS

| Loin Pairs	Standard-Choice$_0$			Good-Prime			Choice$_1$-Choice$_2$		
	Lab. Panel Trios	Consumer Panel Ratings	Pref.	Lab. Panel Trios	Consumer Panel Ratings	Pref.	Lab. Panel Trios	Consumer Panel Ratings	Pref.
A	**	NS	NS	NS	**	**	**	NS	NS
B	NS	*	*	**	*	*	NS	NS	NS
C	**	*	**	NS	NS	NS	*	NS	NS
D	**	**	**	NS	*	NS	*	**	*
E	NS	**	*	NS	**	**	**	NS	NS
F	NS	NS	NS	**	NS	NS	NS	NS	NS
G	**	**	**	NS	NS	NS	NS	NS	NS
H	NS	**	*	**	*	*	NS	NS	NS
I	**	*	*	NS	*	*	NS	NS	NS
J	NS	*	*		NS	NS	NS	NS	NS
K	**	**	**	**	*	*	**	NS	NS
L	**	**	**	NS	*	*	NS	NS	*
M	**	**	**	**	**	*	**	*	*
N	**	**	*	**	**	*	NS	NS	NS
P	--	**	**	--	NS	*	--	*	NS
R	--	NS	NS	--	NS	NS	--	NS	NS
S	--	**	**	--	**	**	--	NS	NS
T	--	**	**	--	NS	NS	--	**	**
U	--	**	**	--	*	**	--	NS	NS
V	--	NS	NS	--	**	*	--	NS	NS
W	--	**	**	--	**	**	--	NS	NS
Totals	9**	13**	11**	6**	7**	5**	4**	2**	1**
	0*	4*	6*	0*	7*	9*	2*	2*	3*
	5NS	4NS	4NS	7NS	7NS	7NS	8NS	17NS	17NS

*.05 level.
**.01 level.
NS - Not significant.

result entirely from guessing, and the estimates are therefore too high. About 65 percent of the switches were from the fatter grades to the leaner grades. The preference data by loins indicate that there was significant consumer discrimination between 17 Choice-Commercial, 13 Prime-Good, and 4 Choice$_1$-Choice$_2$ loin comparisons (Table 17). While significant discrimination indicates that there is an extremely low probability of that number of consistent preferences occurring if *all* tasters were guessing, it does not indicate that none were guessing. It is quite obvious that some consumers were guessing but others were changing their preferences between replicates.

Estimates of discrimination between pairs of loins were almost identical for preference and acceptance rating data (Table 17 and Figure 6). This close agreement resulted from the extremely low proportion of consumer disagreements concerning preferences. For example, if five respondents had consistently preferred standard loin F and seven had consistently preferred Choice$_0$ loin F, then

Fig. 6—Number of Loin Pairs Significantly Discriminated Between, According to Three Measures of Discrimination.

(a) laboratory panel; (b) consumer ratings; (c) consumer preferences
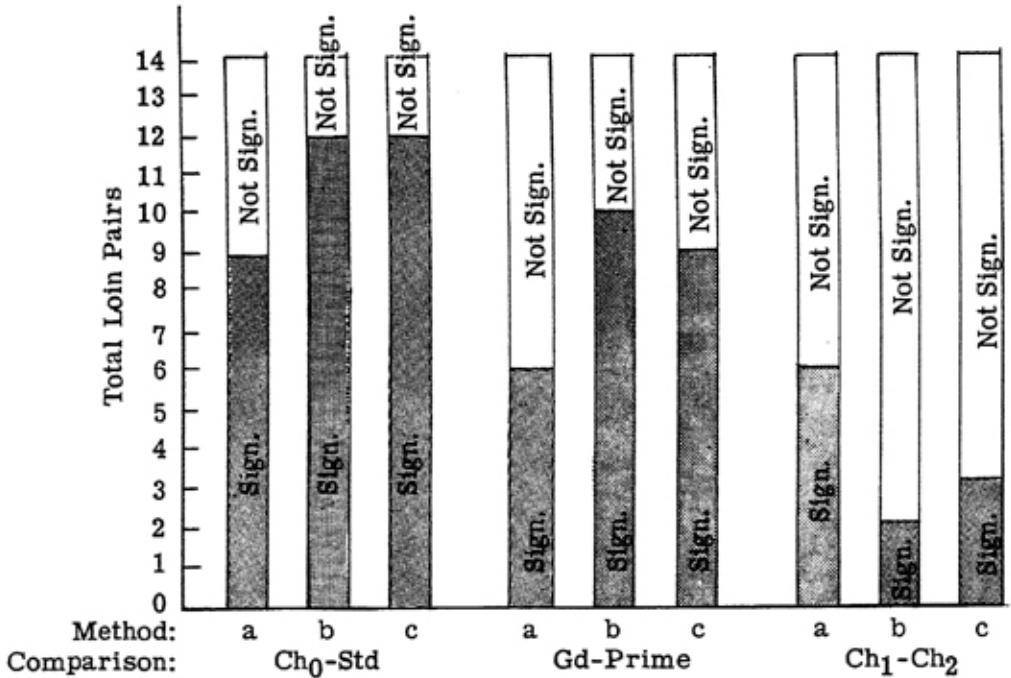
preference data would have indicated significant discrimination, but acceptance ratings probably would not have. This type of consumer disagreement as to preferences did not occur. Apparently consumer eating preferences for loin steaks are homogeneous at equal prices. Perhaps they crudely approximate the situation of identical preferences with a range of tangency described in Case III, theoretical section of Research Bulletin 612.[4] Of course, consumer agreement as to which of two products is preferable does not necessarily imply consumer agreement as to substitution ratios between those two products.

Evaluation of Preferences as Market Indicators

There has been a general abandonment of the simple idea that a 2:1 preference ratio between products A and B indicates that twice as much A can be sold as B under most circumstances.[10] If the less popular product were the more expensive, most merchandisers handling only one product would have little hesitation in discontinuing it. However, the generally less popular grades in this study were shown to be less expensive. Will the lower cost offset the lesser popularity of a leaner grade, and make it a good product to merchandise? Many successful meat merchandisers presently say, "No," and some say, "Yes." Another related question arises: Does the successful merchandising of a leaner grade require a very price-conscious market?

This experiment gives some indications of answers to these questions but certainly does not provide adequate answers. There is no indication that basic eating preferences are related to income. Lower-income families as well as higher-income families prefer most Prime steaks to most Good steaks when there is no price differential. This preference is very slight in many cases. The less the degree of influence of price upon steak sales, the greater is the probability that Choice or Prime should be merchandised. The greater the degree of influence of price upon steak sales, the greater is the probability that Good—or even a leaner grade—should be merchandised. Many large supermarkets in St. Louis merchandise *both* a lean and a fat grade.

More information is needed in two areas. First, *how much* is the difference in eating acceptability of loins and other cuts of leaner and fatter carcasses? Second, what is the *relation* of price differences to acceptability difference? As indicated elsewhere (Research Bulletin 651),[5] the acceptability differences of Choice and Prime loins were generally very small. The eating acceptability differences of Prime and Good loins were generally somewhat larger. However, 19 of the 21 Good loins rated as good or better than the poorest Choice loin. Table 8 shows that loins from Prime carcasses T, C, R, G, L, F, and J were consistently preferred by only four or fewer men. There is certainly reasonable doubt that these loins were much, or any, better—eating-wise—than the Good loins with which they were paired. Much larger samples of loins of the various grades are needed to give reliable estimates of the relation of variation in acceptability to the degree of carcass finish. There is little doubt that a "grade" of leaner carcasses just as acceptable as Choice could be secured if an accurate sorting method were available. Perhaps improved methods of tenderization will someday greatly enlarge the proportion of leaner loins and other cuts which are that acceptable. This would almost certainly reduce the amount of fattening of cattle.

What is the present relation of price differences to acceptability ratings? Every schedule which obtained preferences also obtained the respondent's answer to this question: "How much more per pound do you think you would be willing to pay for the steak you like best?" This direct attack on the problem was not very successful. A mean price differential of 7½ cents was given by those consistently preferring Good, 10 cents by those preferring Prime, and 8 cents by those who were inconsistent. Of 110 women inconsistent on Prime-Good comparison, 31 on the first replicate indicated a difference of 15 cents or more. The magnitude of the price difference was related positively to the acceptance rating difference. However, the meaningfulness of the absolute magnitude of the price differences is certainly suspect. Considerable difficulty of consumers with the whole general concept was noted. If homogeneous products could be obtained consistently, sales tests should help to answer this question.

Consumption Data

A general interview was made to obtain certain consumption data and to

determine panel eligibility prior to actual recruitment of the tasting panel. Twenty general schedules were obtained in each of the 38 sample tracts. In addition, certain other data were obtained in a final interview with the 266 cooperators. Many answers may be compared with results in the 1954 St. Louis study.[3] However, the populations were not identical as Madison and St. Clair counties in Illinois were not included in the present study.

Respondents ranked freshness, tenderness, flavor, and juiciness in order of importance as eating characteristics of steak. Percentages of first ranks were freshness, 50.5; tenderness, 29.0; flavor, 18.2; juiciness, 2.3. Obviously, freshness was extremely important. The percentage of first ranks in 1954 were tenderness, 56.7; flavor, 30.1; juiciness, 8.5; and amount of fat, 4.7. (Freshness was not included in the list.) There was little association of rankings with education or income except that the lower-income households placed a little more emphasis on freshness.

Respondents in both studies were asked the question, "Do you attempt to make more tender the steak you ordinarily buy?" "Yes," was the response of 40.1 percent in the 1954 study, and of only 23.8 percent in the 1955 study. Use of commercial tenderizers was reported by 10.9 percent and pounding by 9.1 percent of the respondents in 1955 as contrasted with 8.9 and 26.0 percent, respectively, in 1954. Satisfaction with commercial tenderizers was reported for 17 percent of Phoenix and Houston samples and 19 percent of a Denver sample. Much higher percentages had tried tenderizers but had found them unsatisfactory.[11]

The panel members were asked for "pet peeves" about the beef steaks they had purchased. No "pet peeves" were reported by 71.4 percent. Percentages of total respondents by complaints were toughness, 13.9; gristle, 1.5; too much bone and/or fat, 4.5; poor flavor, 0.7; dryness, 0.7; inconsistent or unpredictable quality, 1.5; size or thickness, 1.5; unavailability of preferred cuts, 1.1; and price, 3.8. Perhaps lack of freshness was not mentioned as a "pet peeve" because shoppers avoided it by visual inspection. Lack of tenderness was the principal complaint. It is interesting that about 30 percent of those who had no "pet peeves" used some form of tenderization.

All experimental steaks were trimmed to have one-half inch of external fat or less. This close trim was "liked" by 80 percent, was considered too much by 10 percent, and was considered too close by 10 percent of the panel. These members were asked: "Do you eat most (or all) of the fat on various beef cuts?" "Does your husband?" "Do your children?" The answers were, "Yes," for 29.7 percent of the wives, 32.7 percent of the husbands, and 18.6 percent of the children. Only 2.2 percent of those women who said, "No," wanted more fat than was on the panel steaks. However, 26.6 percent of the women who said, "Yes," wanted more fat than was on the panel steaks. Larger families and higher-income families were a trifle more receptive to more fat than were smaller families and lower-income families.

There was no discernible relation of men's occupations to their beef fat consumption. The less the education of the housewives the larger the propor-

tion who ate most or all of the beef fat.

Housewives were named in 75 percent of the households as the principal meat shopper. Men were the principal shopper in 14 percent of the cases; the husband and wife usually shopped together in the remainder of the households. Thirty percent of the shoppers had less than a ninth-grade education.

National chains were named approximately 30 percent of the time as the store where most beef was purchased. Two local chains were named about 17 percent of the time. About three out of four respondents reported buying all their meat and groceries at the same store. About 40 percent of the families shopping at one of the local chains reported family annual incomes after taxes of $6000 or more. However, the percentages in that income group shopping at national chains and independents were only 27 and 21, respectively.

Average one-way distance traveled to one local chain of large supermarkets was 28 blocks. Average one-way distance traveled by all respondents was 17 blocks. However, the median distance was only 5 blocks while the upper quartile traveled one mile or more.

The 266 households named 307 meat sources. Only 62 were in the same census tract; 145 were outside the tract; 59 were on the tract boundary; 41 were unlocated. Several of the unlocated sources were meat salesmen, farmers, and other non-retail sources. Only 131 different stores were named since many stores were named more than once.

Only one out of three households reported they did not have a locker, home freezer, or large freezing space in their refrigerator. Most of the frozen storage spaces were freezing compartments in refrigerators, however. About 45 percent of the households had freezer storage space exceeding 50 pounds. The higher the household income and education the greater the proportion having freezer space and the greater the average size of that space. Almost all respondents who stored any frozen meat obtained it from a retail store. Only three families obtained meat through a food plan.

Panel members were asked if they would be willing to buy frozen meat in non-transparent packages from their grocer. Almost 80 percent of the housewives in 1955 said that they would not want to buy meat in opaque packages.

More respondents (40 percent) reported beef in their freezer storage than any other item. Only 25 percent reported pork while greater percentages reported vegetables, fruit, juices, and poultry.

Respondents were asked whether or not they had served certain cuts in the past two weeks. Percentages who reportedly had served various cuts were beef steaks or roasts, 95.9; hamburger, 90.8; pork chops, 66.8; ham, 58.5; pork sausage, 38.8; and picnic shoulders, 10.0. Percentages of all households using specified cuts in the 1955 survey of the North Central Region were beef steaks, 59.1; beef roasts, 40.1; pork chops, 42.1; cured ham, 34.9; and pork sausage, 20.4.[12] These percentages are not directly comparable because the latter survey included one

week's consumption rather than two. It is also probable that picnic shoulders were frequently reported as ham.

Proportion of households consuming pork chops was 57.6 percent in the group of housewives with 12 or more years of education compared to the general average of 66.8 percent. There was a slight positive relation to income of percentage serving ham. All groups served hamburger frequently. The 18 households with a member over 70 years old appeared to consume all cuts less often than younger people. Perhaps older people need specially designed meat products.

Respondents were asked, "Does your family eat more pork or beef?" Six percent said, "Pork"; 76 percent said, "Beef"; 18 percent said, "About the same amount of each."

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