

RESEARCH BULLETIN 676

SEPTEMBER, 1958

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

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The Effect of Continued Testing Upon Consumer Evaluation of Beef Loin Steaks

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(Publication authorized September 5, 1958)

COLUMBIA, MISSOURI

SUMMARY AND CONCLUSIONS

For a period of 12 weeks 60 Columbia families made comparative evaluations of loin steaks in these groupings: Choice—Standard₂, Good₁, and Good₂—Commercial Cow.* The study was so designed that the group of steaks evaluated in each household comprised six or 12 replicates from the same carcass. Researchers used results thus obtained in an attempt to ascertain the influence of experience upon preference and relative acceptability of various beef grades. Although the scope of the study was inadequate for inferences to the consuming public in general or even to the entire Columbia populace, such respondent evaluations made under actual consumption conditions added to the fund of measurement and predictive data in these phases of the study of beef.

Mean acceptability ratings of carcasses, as identified by grade and shear, showed almost no over-all trend in variability with continued tasting, nor were there any significant differential trends associated with particular grade or shear measurements.

This degree of stability over time is very encouraging as it suggests that sustained testing of the same respondents is not necessary for consumer preference experiments.

Considerable variation was found in respondents' ratings, over time, which was unrelated to any trend. This variation was related to size of means and was probably partly a scale effect. Some individuals were much less consistent than others. While the loins varied considerably in acceptability, some of the variation in acceptability and preferences can be explained by differences in people.

In evaluating particular carcasses within each grade, households did show significant differences in their acceptability ratings. In 30 cases of the same loin being eaten by two families there were 12 cases of significant disagreement in ratings between these families. In the 30 cases of the same loin eaten by four families there were 13 cases of significant disagreement in acceptability among the four families.

Significant differences did exist in preferences by grade and shear group. Most notable were the differences in favor of the higher grades in the Good₂—Commercial Cow and Choice—Standard₂ comparisons. However, the relationships between shear value and acceptability and preferences appeared to be slightly stronger than the relationships of grade to acceptability and preferences.

Acceptability ratings and preferences of husbands and wives were much alike. While some differences in ratings and preferences were found by socioeconomic and cooking classifications, numbers were so small in these subgroups as to limit severely any inferences.

Coefficients of simple correlation between loin mean ratings by a laboratory panel and consumers were: tenderness, 0.69; flavor, 0.56; and juiciness, 0.13.

A high degree of cooperation was maintained over the 12-week testing period with only 1½ percent loss of data. The required payment of \$7.50 at the onset of the study may have made respondents a little more critical in their ratings but probably helped to maintain cooperation.

*Subscripts are employed for identification and do not imply divisions within the grades.

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ACKNOWLEDGMENTS

Appreciation is expressed to Mrs. Richie Thornton for assistance in writing and to Mrs. Lee Owens for assistance in interviewing. The bulletin is a report on Department of Agricultural Economics Research Project 86, "Meat Preferences," Animal Husbandry Project 5, and Home Economics Project 109.

Portions of this analysis are reported in a Master's thesis submitted to the University of Missouri by Max F. Jordan.

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INTRODUCTION

Statement of Purposes

More than one reader—and author—of consumer preferences studies has asked himself: "How reliable are these results? What is the effect of experience with a product upon consumers' preferences? What are the sources of variation?"

The primary purpose of this study is to determine the influence of continued tasting of specified grades of beef upon the relative acceptability ratings of the preferences for those grades. The study attempts to measure the influence of experience or time on preferences and acceptability ratings.

The secondary purpose of this study is to determine further the comparative acceptability of the selected grades of beef. The study attempts to add to the criteria used to evaluate the effects of (a) shear values of the loins, (b) income levels of the respondents, (c) cooking methods and (d) age and education level of the respondents upon the acceptability ratings of selected grades of beef. It also attempts to relate these acceptability ratings to the federal carcass grades.

Certain methodological objectives were also involved in this study:

1. To determine the degree of cooperation that can be maintained in a consumer panel over a period of 12 to 14 weeks.
2. To determine the problems and results of using as many as 6 replications from a single loin in the same household in an attempt to determine family variation.
3. To determine the relative acceptability of steaks from Commercial Cow carcasses.
4. To determine the influence of respondent investment in the study upon the accuracy and completeness of the results over a period of time.

The following null hypotheses were adopted as a guide for the study:

1. The mean acceptability ratings of loins as identified by grade and shear groups do not vary with continued tasting.
2. Preferences for loins as identified by grade and shear do not vary with continued tasting.
3. There is no difference among acceptability ratings of various grades and shear groups tested.

4. There is no difference among preferences for the various grades or shear groups tested.

EXPERIMENTAL PROCEDURE

Population Sampled

The sample for this study was drawn in Columbia, Mo., a city with a population of approximately 43,000 and an area of 10 square miles. Four geographic areas of the city, thought to represent broadly different income levels, were arbitrarily chosen. Through the use of the city directory, households were selected at random to represent each of the four areas. Preliminary interviews were held to obtain 15 eligible white households in each area willing to participate.

To qualify as a cooperating household, families met the following requirements:

1. Cooperating adults had to be under the age of 70 years.
2. The same two adults agreed to eat all the meat supplied and to cook the meat to the same degree of doneness by the same cooking methods throughout the period.
3. Cooperators had to be in Columbia for 14 weeks after the beginning of the study.
4. Each household had to pay the sum of \$7.50 for the meat consumed during the test period.
5. Persons participating must have had no previous meats training or meat-cutting experience.
6. Cooperating adults had to like and be able to eat pork as well as beef, since a pork study was conducted concurrently with the beef study.

The Product

Four grades of beef were selected for this study. Comparisons were made between adjacent and non-adjacent groupings: Choice—Standard₂, Good₁—Standard₁, and Good₂—Commercial Cow. The two lower grades were selected because they lack homogeneity—a fact established in previous studies^{1**}—and the Choice and Good grades because retail stores handle these grades more frequently.

Loin steaks—with the tenderloin and ventral, vertebral processes removed—were chosen mainly for two reasons.

1. They are good representatives of the carcass grades.
2. On the basis of the wide range in market prices for short loins, consumer preferences for the cut presumably vary more than for any other wholesale cut.

One hundred and thirty loins were obtained from carcasses selected in packer coolers by a representative of the University Meats Section. The purchase in-

**Numbers refer to list of references in the back.

cluded 20 pairs of Standard loins, 22½ pairs of Good loins, 12½ pairs of Choice loins, and 10 pairs of Commercial Cow loins. The originating carcasses, representing the middle of the grade, ranged in weight from 550 to 612 pounds for Commercial Cow and from 500 to 550 pounds for the other three grades.

All loins were aged at 38° F and 70 percent humidity in the University Meats Laboratory for 12 days after slaughter. Before the loins were frozen, 1½-inch thick shear steaks were cut from the left loin in each loin pair to provide 3 one-inch cores per steak. Three readings were made on each core to determine the mean shear value of each carcass.†

Thirty steaks, ¾-inch thick, for use by the consumer panel and one shear steak were cut from each pair of loins. For the laboratory panel two steaks, ¾-inch thick, were cut from the left loin of the pairs; and four steaks, ¾-inch thick, were cut from the right loins.

Assignment of Loins and Experimental Design

Five households within each of the four neighborhoods were assigned, at random, to one of the three grade-comparison groups. Each of these three groups of 20 families was to receive steaks in the same grade comparison throughout the 12 weeks of testing. Two families in each grade comparison were to sample the same carcasses each week. Assignment of pairs of carcasses to households was made at random.

Carcasses within grade-comparison groups were arbitrarily grouped by pairs into "like" and "unlike" shear categories†† according to shear pressures. All left loins were matched in "unlike" shear groups and all right loins were matched in "like" shear groups so that each carcass would be evaluated in both shear groups.

Each carcass was evaluated an equal number of times, although one-half of the carcasses were tasted by 2 households and one-half of them were tasted by 4 households. In a given grade comparison the same two households each judged a carcass (A) in an unlike shear comparison with another carcass (B) in 6 tests, and in a like shear comparison with still another carcass (C) an equal number of tests. Further, B was judged in a like shear comparison with another carcass (D) and C was judged in an unlike shear comparison with another carcass (F) by two other families.

Thus, each household compared steaks from three loins and from two grades. Each household evaluated steaks from one loin in all 12 tests and from two other loins in 6 tests each. The design does not permit a test of transitivity of prefer-

†A pair of loins from the same carcass are often referred to as a "carcass" to distinguish them from loins experimentally paired and originating from different carcasses.

††Originally "like" shear was defined as a mean shear difference of from 0 to 3 pounds inclusive; and "unlike" shear, from 6 to 9 pounds inclusive. However, the narrow range of shear values in the loins purchased made it impossible to maintain division at these levels.

TABLE 1--HOUSEHOLD AND CARCASS COMPARISONS

Unlike Shear Comparison			Like Shear Comparison		
Carcasses Compared	Households Judging	Total Times Judged by 4 Persons	Carcasses Compared	Households Judging	Total Times Judged by 4 Persons
A & B	# 1 & 2	24	A & C	# 1 & 2	24
D & E	# 3 & 4	24	D & B	# 3 & 4	24
F & C	# 5 & 6	24	F & G	# 5 & 6	24

ences. The general comparison design used for all carcasses is shown in Table 1.

Each steak was cut in half so both adult panel members in each household could taste every one. An aluminum ring clamped around the bone in both halves of one of the steaks in the particular comparison identified steaks during cooking and preparation. Each loin was identified by rings an equal number of times in an attempt to minimize ring bias. One respondent was to eat an upper half steak bearing a ring and an upper half without a ring. The other respondent was to eat the lower halves, one with a ring and one without a ring.

After being cut and coded, steaks were wrapped as test pairs in freezer paper, placed in paper bags, marked with household and test numbers, frozen at -10° F, and stored at 0° F until delivery.

Delivery

Weekly deliveries of meat were made from insulated boxes and commercial cooler chests to prevent thawing during the distribution process. Deliveries were made on Monday and Tuesday in an attempt to reduce the temptation to hold any of the samples over for weekend guests. It was felt that the direct weekly contact with the respondents and the obvious attempt to adapt the delivery schedule to the convenience of the household were instrumental in maintaining a high level of interest and cooperation.

Household Evaluation

The two adults each evaluated each steak on a hedonic scale with nine descriptive phrases ranging from "Like Extremely" to "Dislike Extremely." Each adult also indicated a preference between the two steaks. The hedonic scale was later assigned numbers from 1 to 9 beginning with 1 for "Like Extremely" for purposes of analysis. Since differences between the mean ratings and preferences of men and women were very small, a considerable part of the analysis is based on the data of men only.

RATINGS AND PREFERENCES OVER TIME

Trends

An improvement between the first and second replicates in the acceptability ratings of leaner loin steaks and a decline in the ratings of fatter steaks were noted in a recent eating test at Missouri.¹ The null hypothesis tested in the pres-

ent study was: there is no trend of ratings or preferences over time.

Acceptability Ratings. This null hypothesis was, in general, correct. The mean ratings of each grade for each replicate did vary considerably over time, but evidenced little or no consistent trend (Figure 1). The Good grade (both Good₁ and Good₂) possibly had a slight upward trend; ratings of both Good₁ and Good₂ moved generally upward after replicate seven; the mean of the last three replicates of Good₁ and Good₂ is higher than the mean of the first three replicates by about 0.5 of a point. Ratings of Commercial Cow moved somewhat lower than the ratings of the other grades which generally moved together fairly closely, although there were exceptions. It should be noted that Good was the fatter grade in these particular comparisons rather than the leaner.

In these tests, the mean ratings of Good improved and the mean ratings of Choice declined from replicate 1 to replicate 2 as had occurred in the St. Louis experiment. However, the large number of variations during 12 tests suggests that a trend factor is of extremely little importance in explaining the variation from replicate 1 to replicate 2 in the two experiments. At this stage of the investigations, the major cause of these variations apparently must be labeled "chance."

Comparison of grade means by like and unlike shear groups for three replicate groups (two consecutive tests per group) shows much the same pattern. Good grade in the unlike shear situations is the only grade showing any trend (Figure 2). It will be recalled that the two shear groups contained the same beef—the like group contained the right loins and the unlike group contained the left loins—but that pairings were made in the like group to minimize shear differences and in the unlike group to maximize shear differences.

A detailed study of ratings of each loin by tests found only 5 loins with convincing evidence of trends, and they were distributed in 3 grades. There were twelve other loins showing slight and rather uneven trends upward and 5 loins with similar trends downward. These loins were also distributed rather evenly among grades.

The mean of all ratings of all grades would be expected to be very stable over time in the absence of trends by grades. While this mean was relatively stable, it varied by tests from a high of 3.55 to a low of 4.23. The path of means by tests first moved upwards and then down and then back up again (Figure 1).

FIG. 1—MEAN RATINGS OF GRADES BY TESTS.

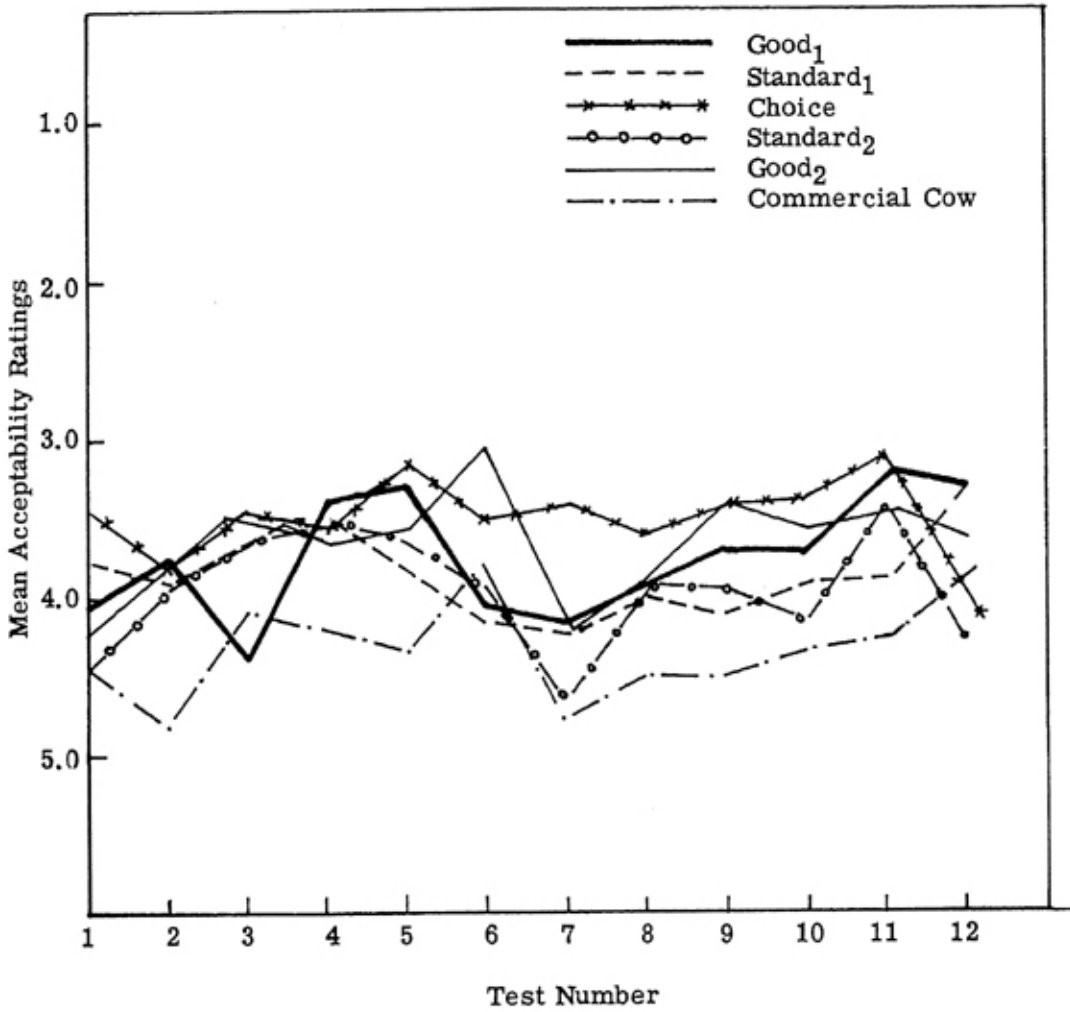


FIG. 2—TRENDS IN RATINGS OF GRADES BY MEN.

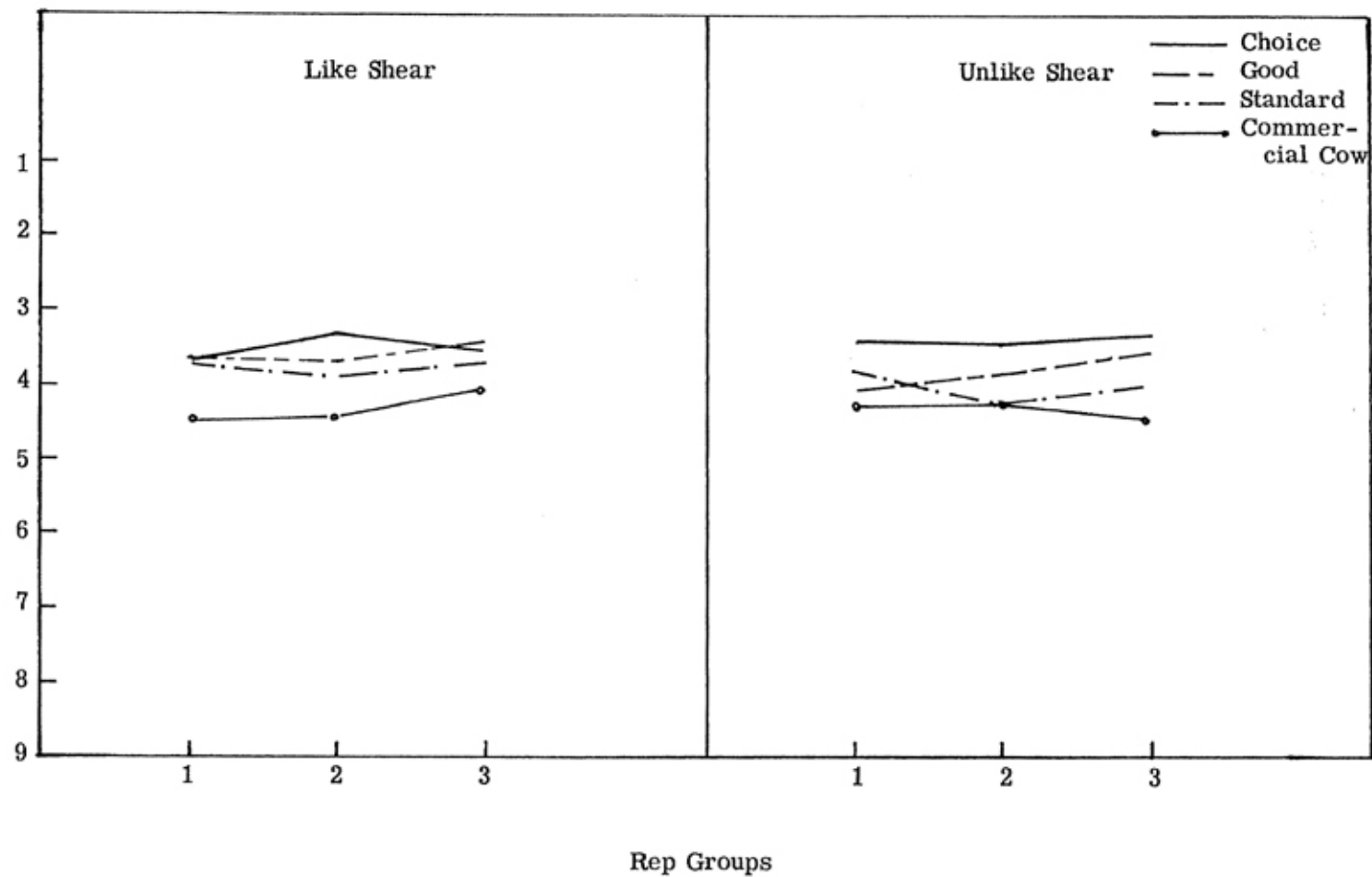
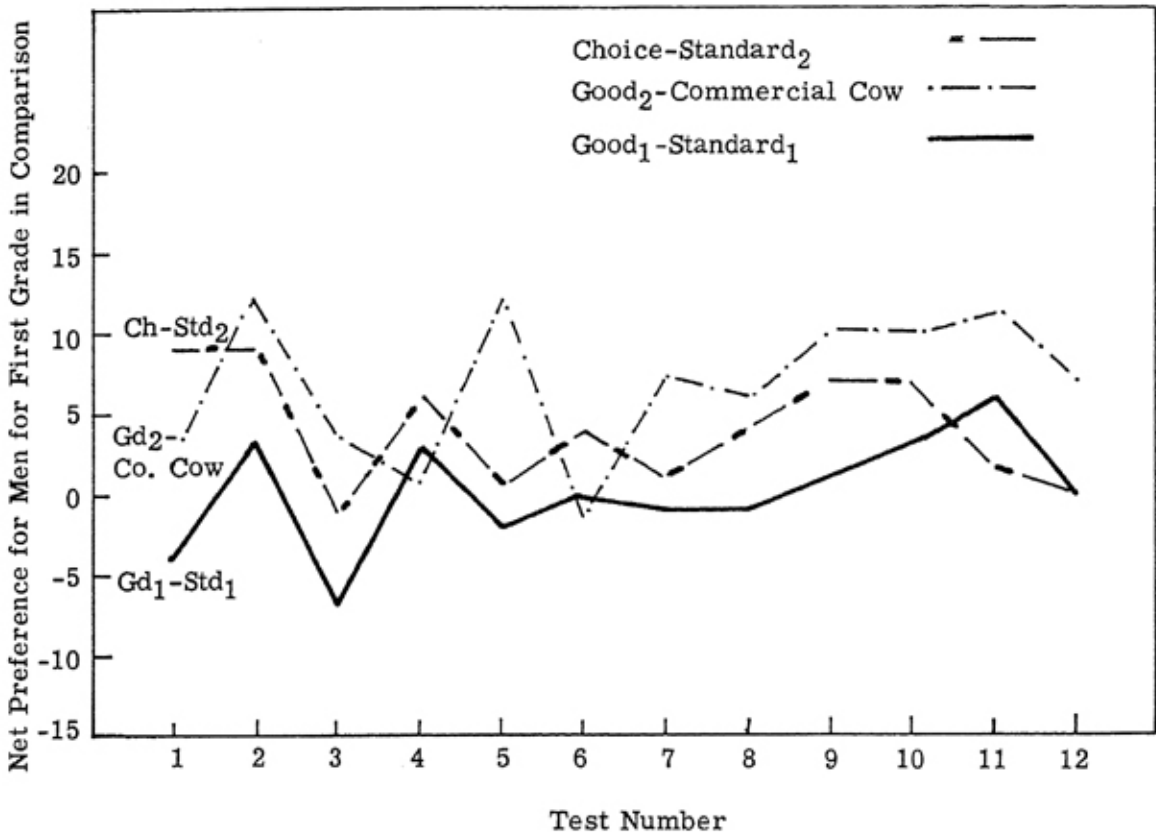


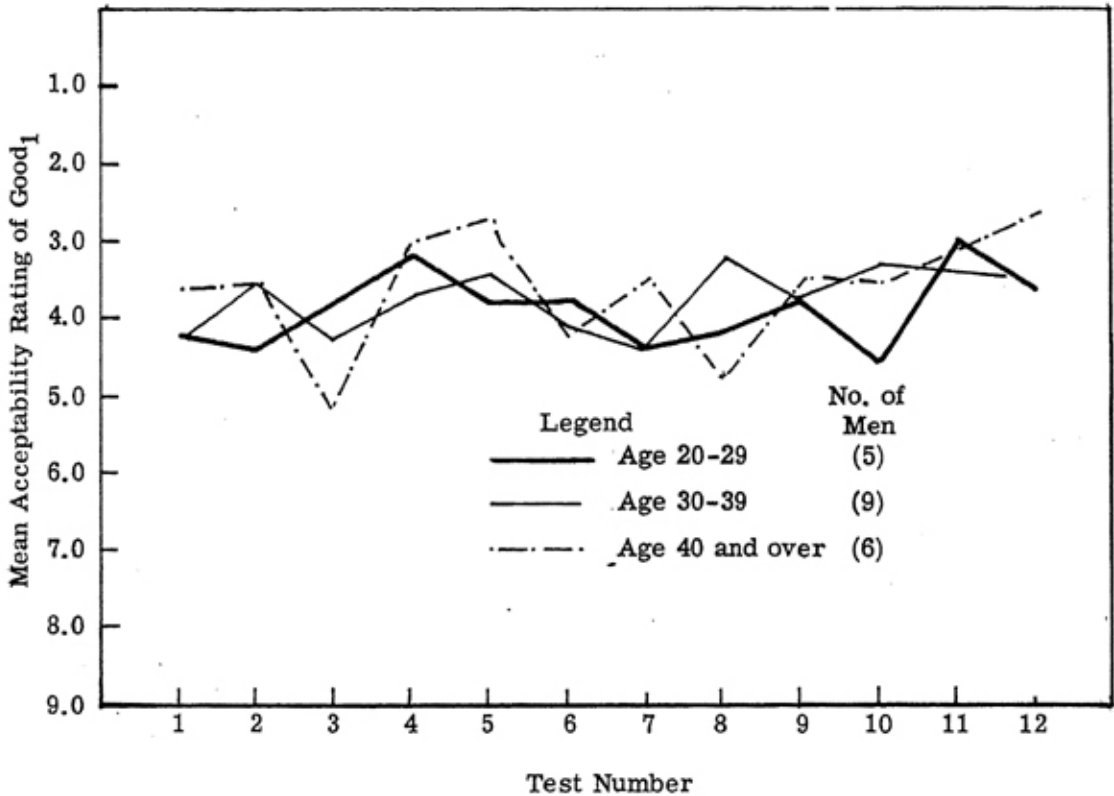
FIG. 3—NET PREFERENCES BY TESTS.



Preferences. There was a very slight trend downward over time in the number preferring Commercial Cow and upward in the number preferring Good₂. Likewise there was a very slight trend upward in the net preferences for Good₂ over Commercial Cow (Figure 3). Aside from these two very tentative indications of trends, there was no other evidence of trends over time.

These findings suggest that the obtaining of two or three replicates per family for as many families as possible is sufficient for establishing preferences or acceptability ratings for a carcass. Preference research would be tremendously complicated if initial preferences had been shown to have little relation to preferences after considerable experience. Of course, these results do not suggest possible results of deliberate attempts to "educate" or change preferences over time. Moreover, these results have other limitations in terms of sample size and type of experimental controls which limit far-reaching inferences. In lieu of contrary evidence, it seems reasonable to assume that preference or acceptability results from the last few weeks of a consumer tasting panel will be very similar to results from the first few weeks.

Variation in Ratings and Preferences Over Time. A few comments should be made on variation independent of trend. Such variation has already

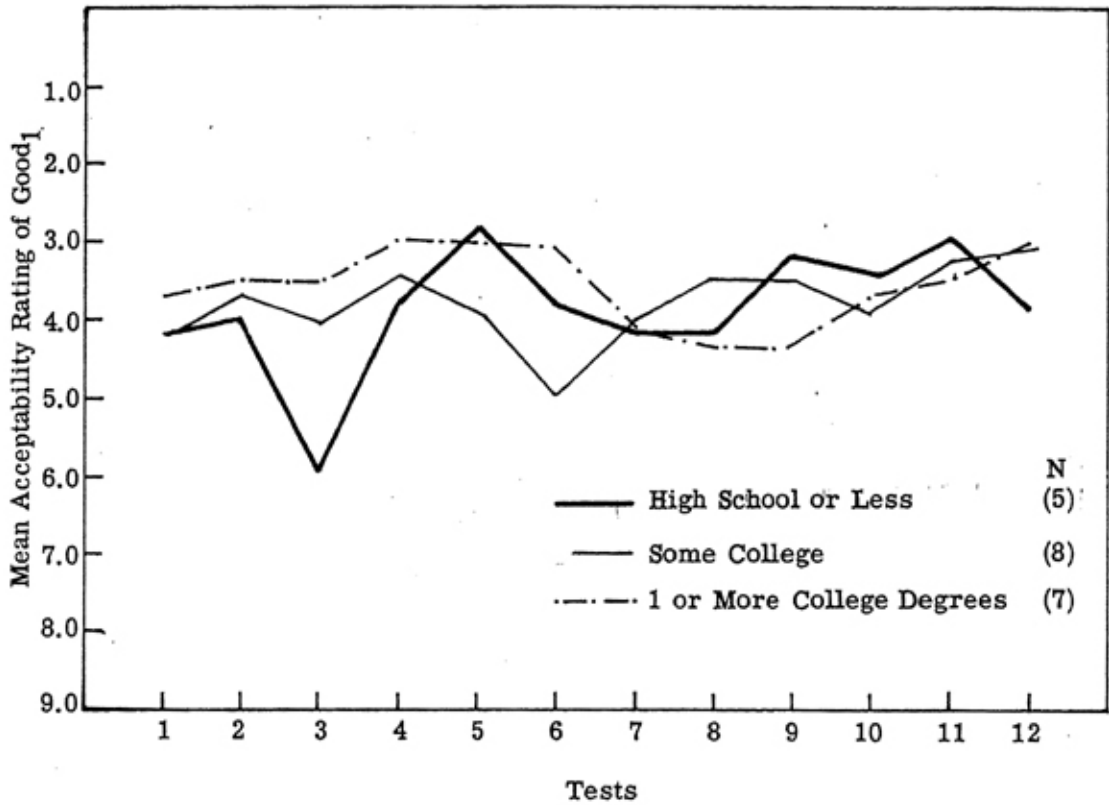
FIG. 4—MEAN RATINGS OF GOOD₁ BY MEN BY AGE GROUP.

been indicated to have been rather large. Unfortunately, very little light can be thrown on its causes. A rather thorough analysis follows of variation among households evaluating the same loins and of variation within a household evaluating a given loin.

There was considerable variation from test to test in the mean ratings and number of people preferring each grade. The Choice grade means and preferences were a trifle more stable than the other grades but the difference was small and possibly not significant (See Figures 1 and 3).

The variation by tests in the evaluation of Good₁ by three age groups of households is shown in Figure 4. Those households with average ages in the 30's were most stable and those households averaging 40 and over were the least stable. However, only 5 households were in the first group, 9 in the second, and 6 in the third, so these results must be treated with caution.

Other evidence suggests that the better educated gave more stable ratings over time for the same grade than those less well educated (Figure 5).

FIG. 5—MEAN RATINGS OF GOOD₁ BY TESTS AND BY EDUCATION.

Variation Among Households Evaluating Same Loins

There are two related but somewhat different aspects to this problem of inter-household variation arising because of the experimental design. (1) Each of the 60 loins was consumed by either two or four households, so differences between or among households can be obtained for 60 loins. (2) Each of 30 pairs of households received samples from the *same three loins*. Thus the results for three loins can be compared for each of these 30 pairs. It is possible for one household to rate one loin or even all three significantly higher than another household and yet to "rank" all three loins in the same order as the second household. Such an occurrence would indicate a "hedonic" effect (different hedonic ratings in general), which possibly reflects a difference in absolute acceptability but not in relative acceptability.

Acceptability Ratings. Differences in household means per loin for those evaluated by two families ranged from 4.83 to 0.33 and averaged 1.19. Differences between the highest and lowest household means per loin for those evaluated by four families ranged from 5.33 to 0.84 and averaged 2.10. Note that the three biggest differences among families—5.33, 4.83 and 4.66—were all as-

sociated with Household 47 rating down severely all three loins tasted. Household 45 also rated very critically all loins tested (Appendix Table 20). It should also be noted that each household mean was based upon twelve or six ratings and on only the ratings of the men. Differences in mean ratings of loins by households were significant for 25 of the 60 loins (Table 2 and Appendix Table 21).

TABLE 2--DIFFERENCE AMONG HOUSEHOLDS RATING SAME CARCASSES

I. Two Households Rating Same Carcass	No. of Carcasses	
	Sign. Diff. *	Not Sign. Diff.
Good ₁	5	5
Standard ₂	1	9
Commercial Cow	6	4
<hr/>		
II. Four Households Rating Same Carcass		
Good ₂	6	4
Standard ₁	3	7
Choice	4	6
	25	35

* 95% level of significance of F ratio.

There was complete rank agreement among loin means for 7 pairs, partial rank agreement for 14 pairs, and no rank agreement for 9 pairs of the 30 pairs of households evaluating three loins each (Appendix Table 20). For 20 pairs there was rather poor general agreement of mean scores for loins, but only 7 of these had no rank agreement, while 2 had complete rank agreement. Thus the mean acceptability scores per loin indicate that about one-fourth of the households ranked the same three loins in the same order, while another one half of the households ranked them in somewhat the same order.

Part of the household disagreements in ranking can be accounted for by very similar ratings for all three loins. There were differences of 1 point or more in the three means for each household in only 10 of the 30 pairs. Within these 10 households were 4 of the 7 cases of complete rank agreement, and 2 of the 9 cases of no rank agreement.

Thus, there was much general agreement among households concerning the relative acceptability of loins but there were also significant differences among households. This in itself is an interesting finding. This finding does indicate cautions in interpreting the loin data for this experiment. Since each loin was evaluated by two or, at most, four families, individual loin means can be influenced by particular household preferences. The design previously used in experiments minimized the influence of individual preferences by distributing a loin among 12 to 14 families. It might also be noted that the absence of sufficient samples from a carcass to allow separation of possible consumer variation from carcass variation greatly hinders consumer evaluation of the smaller muscle areas.

Preferences. Preferences for each pair of 60 pairings of loins were given by

two households (Table 3). A total of 12 preferences were expressed for each household by the husband and wife. Thus the maximum possible difference in preferences for a loin between the two households would be 12. The median difference in preferences was 2, the mean difference was 2.6, and the range was 0 to 9. For six "loins" the difference was 7 or more, and for 23 of the 120 "loins" it was zero.‡

For 24 of the 60 comparisons preferences were enough different between households to suggest "majority disagreement". That is, in these 24 cases of disagreement a majority of one family's preferences were for one loin in the pair while a majority of the other family's preferences were for the other loin or else were evenly divided between loins. However, differences of only one—such as 6 to 5 versus 5 to 6 or 6 to 6—were not considered as "majority disagreements."

The same conclusion of much agreement but a significant amount of disagreement must be made for preferences as for acceptability ratings.

Variation Within Households

Acceptability. Standard deviations of acceptability ratings by loins within households ranged from zero to 3.29 (Table 20, Appendix). Sixty loins rated by 39 men had standard deviations under 1.00. Ninety-eight loins rated by 50 men had standard deviations from 1.00 to 1.99. Twenty-two loins rated by 14 men had standard deviations from 2.00 to 3.29. Standard deviations exceeding 2.0 on a 9-point scale are obviously very large and those exceeding 1.0 are rather large. A recent relatively inexperienced panel tasting steaks under laboratory controls at this Station had somewhat smaller standard deviations. It should be realized that rating scales are sensitive enough to reflect environmental conditions as well as product conditions.² Therefore, we would expect more variation from a household panel tasting over a 12-week period than from a panel tasting two weeks under laboratory conditions.

The desirability of excluding data from families with excessive variability of ratings has been debated.³ While such exclusion may appear desirable from the point of view of determining product differences, these families with high variability should not be ignored as part of the market for beef. Apparently, environmental factors strongly affected the ratings of these people. It is of interest that 3 of the 14 men having standard deviations above 2.0 actually had such values for all 3 loins, while 2 more men each had 2 standard deviations above 2.0. In contrast, all 3 standard deviations of each of 6 men were below 1.0, and 2 standard deviation of each of 9 other men were below 1.0.

Is it possible that the more consistent judges or consumers may be consistent because they rate *all* products about the same all the time? In such cases, their usefulness would be over-rated, because they would not find differences that more variable judges or consumers might find. The evidence in Table 4 pertains to only a few judges, but it does lend a little evidence to the hypothesis

‡Each loin was utilized in a separate comparison so that the 60 loin pairs were utilized in 60 comparisons—each by two households—involving 120 loins.

TABLE 3--PREFERENCES OF ALL INDIVIDUALS BY LOIN COMPARISONS

House- hold No.	Left Loins					Right Loins				
	Carcass No.	No. Pref.	Carcass No.	No. Pref.	No. of No Pref.	Carcass No.	No. Pref.	Carcass No.	No. Pref.	No. of No Pref.
		<u>Good₁</u>		<u>Standard₁</u>			<u>Good₁</u>		<u>Standard₁</u>	
01	05	4	01	8		05	4	52	8	
33	05	9	01	2	1	05	4	52	8	
04	15	2	55	8	2	15	-	01	12	
35	15	4	55	6	2	15	6	01	4	2
13	16	6	45	5	1	16	1	66	8	3
38	16	5	45	6	1	16	6	66	6	
14	17	10	32	2		17	5	50	5	2
40	17	8	32	3	1	17	6	50	6	
15	23	4	50	8		23	8	45	4	
43	23	6	50	6		23	9	45	3	
20	06	3	62	9		06	5	55	7	
51	06	6	62	6		06	-	55	12	
21	21	11	51	1		21	3	39	9	
52	21	8	51	-	4	21	6	39	4	2
23	11	-	52	12		11	7	51	5	
53	11	3	52	9		11	10	51	-	2
24	43	3	39	8	1	43	12	32	-	
56	43	5	39	7		43	12	32	-	
28	03	4	66	6	2	03	12	62		
59	03	2	66	6	4	03	3	62	7	2

TABLE 3--CONTINUED

House- hold No.	Left Loins					Right Loins				
	Carcass No.	No. Pref.	Carcass No.	No. Pref.	No. of No Pref.	Carcass No.	No. Pref.	Carcass No.	No. Pref.	No. of No Pref.
	<u>Choice-Standard₂</u>									
	<u>Choice</u>		<u>Standard₂</u>			<u>Choice</u>		<u>Standard₂</u>		
02	12	10	02	1	1	35	6	02	6	
31	12	12	02	-		35	12	02	-	
06	35	3	56	9		27	4	56	8	
32	35	6	56	5	1	27	2	56	10	
07	29	12	46	-		26	9	46	2	1
34	29	12	46	-		26	11	46	-	1
08	30	10	63	2		04	1	63	11	
39	30	9	63	3		04	6	63	6	
09	37	11	57	-	1	08	7	57	3	2
45	37	5	57	6	1	08	6	57	6	
17	04	12	20	-		30	12	20	-	
46	04	12	20	-		30	11	20	1	
18	26	3	58	9		29	3	58	8	1
48	26	7	58	5		29	7	58	5	
19	28	4	38	8		37	8	38	4	
49	28	3	38	8	1	37	9	38	3	
25	27	8	59	4		28	9	59	2	1
50	27	3	59	8	1	28	6	59	2	4
27	08	5	44	7		12	2	44	9	1
60	08	5	44	6	1	12	8	44	4	

TABLE 3--CONTINUED

House- hold No.	Left Loins					Right Loins					
	Carcass No.	No. Pref.	Carcass No.	No. Pref.	No. of No Pref.	Carcass No.	No. Pref.	Carcass No.	No. Pref.	No. of No Pref.	
	Good ₂ -Co. Cow										
	<u>Good₂</u>					<u>Co. Cow</u>		<u>Good₂</u>		<u>Co. Cow</u>	
03	14	9	33	2	1	13	11	33	1		
36	14	11	33	1		13	9	33	3		
05	13	5	49	7		10	4	49	8		
37	13	5	49	7		10	8	49	4		
10	10	8	65	3	1	14	12	65	-		
21	10	7	65	4	1	14	6	65	2	4	
11	19	6	61	4	2	09	8	61	4		
42	19	6	61	6		09	5	61	7		
12	22	7	60	4	1	18	8	60	4		
44	22	8	60	4		18	9	60	3		
16	18	9	68	3		19	8	68	3	1	
47	18	12	68	-		19	10	68	2		
22	07	4	47	6	2	24	9	47	2	1	
54	07	12	47	-		24	6	47	5	1	
26	24	10	48	2		07	10	48	2		
55	24	3	48	9		07	7	48	5		
29	36	8	64	4		22	5	64	7		
57	36	6	64	6		22	7	64	5		
30	09	12	67	-		36	8	67	4		
58	09	6	67	6		36	8	67	4		

TABLE 4--MEAN DIFFERENCES REPORTED BY MEN OF VARYING DEGREES OF RATING RELIABILITY

	Mean Difference in Ratings of Loin Pairs	
	Left Pair	Right Pair
5 Men With 2 or 3 S.D.'s of 1.0 or Less	0.46	0.55
15 Men With 2 or 3 S.D.'s of 2.0 or More	1.30	0.63

that the most consistent people found—or reported—only very small differences in comparisons. More work needs to be done on this important methodological problem.

The coefficient of simple correlation between loin means and loin standard deviation was 0.63 (95% confidence limits of 0.45 and 0.77). This suggests that an important factor affecting the size of loin—and also household—standard deviations was the position of the means on the 9-point scale. The larger means of 4, 5 and 6 were in the middle of the scale where there was the most “room” for variation in individual ratings. The lower means of 2.62 to 3.99 were associated generally with smaller standard deviations as there was less “room” for variation at the higher end of the scale. However, only about 40 percent of the variation in magnitude of standard deviations is probably explained by the size of the means. Individual household variation has already been shown to have been a causal factor. The evidence is indecisive concerning the possibility that minor explanatory variables of loin standard deviations were grade and whether a loin was evaluated by two or four households. An array of loin standard deviations by grade indicates that there was much similarity by grades but that Good₂ and Commercial Cow loins generally had slightly larger standard deviations (Table 5).

TABLE 5--STANDARD DEVIATIONS OF LOINS RATINGS BY GRADES*

	Gd ₁	Std ₂	Co. Cow	Std ₁	Ch.	Gd ₂
	0.86	0.96	1.18	1.01	0.93	1.18
	1.12	0.98	1.28	1.14	1.13	1.23
	1.24	1.08	1.31	1.23	1.17	1.29
	1.24	1.17	1.38	1.36	1.20	1.32
	1.38	1.37	1.44	1.41	1.26	1.82
	1.41	1.38	1.53	1.50	1.50	1.87
	1.41	1.57	1.98	1.66	1.52	1.93
	1.84	1.59	2.08	1.68	1.76	1.96
	1.88	1.81	2.41	1.80	2.03	2.11
	2.53	2.24	2.80	2.19	2.04	2.45
Mean of S.D.	1.49	1.42	1.74	1.50	1.45	1.72
Median S.D.	1.39	1.37	1.48	1.44	1.36	1.84
Grade Mean	3.65	3.95	4.32	3.85	3.56	3.75
Range of Loin	3.16	2.62	3.42	2.67	2.67	3.25
Means within a Grade	to	to	to	to	to	to
	/ 4.71	6.00	6.50/	/ 5.17	3.96	4.25/
	Two-Family Loins			Four-Family Loins		

*Ratings of men.

The differences in standard deviations by grade are not quite as large as were noted in the St. Louis study. Median standard deviations of loins ranged from 1.20 for Prime to 1.92 for Standard in that study.¹ Since the only exceptional standard deviations were in Commercial Cow and Good₂ grades and since the former was evaluated by two families and the latter by four, there is no evidence that loin standard deviations were affected by the number of families evaluating them. However, standard deviations of Choice and Good loins in the St. Louis experiment and eaten by 12 to 14 families tended to be a little smaller than Choice and Good loins of this experiment.

Preferences. Each household tasted 6 pairs of steaks in each of two comparisons. The preferences of the man in each household were examined for reversals of preference —i.e., preferring each loin part of the time. It is generally believed that the higher the proportion of reversals the more alike are the objects being compared.⁴ It is also possible that the higher the proportion of reversals of preferences, the more erratic are the judgments of those consumers.

Of the 120 comparisons 54 were judged with a high degree of consistency (Table 6), but 31 comparisons had quite inconsistent results (3 to 2 or 3 to 3 or

TABLE 6--TABULATION OF MEN'S PREFERENCES
BY CONSISTENCY GROUPINGS

No. Preferences for Each of the Pair*	No. of Comparisons
6 to 0 or 5 to 0	25
5 to 1 or 4 to 1 or 4 to 0	29
4 to 2 or 3 to 1	35
3 to 2	11
3 to 3 or 2 to 2	20
Total	120

* No preference answers made up the difference whenever total preferences for a pair were less than 6.

2 to 2). These 31 inconsistent comparisons were made by 25 families as six of the families were quite inconsistent on both of their comparisons. However, the mean of the loin standard deviations of these 25 families were no larger than the mean of the loin standard deviations of the other 35 families. These results suggest that the inconsistencies by households were more likely due to particular loins being much alike than to certain families' being more erratic. It goes without saying that the rather large loin standard deviations for most households do suggest that some of the preference inconsistencies should be attributed to variation in subjective judgments for those households.

CONSUMER RESULTS

Acceptability and Preference Related to Grade

Acceptability and Grade. A nine-point hedonic scale used in Part I of the evaluation schedule was designed to measure the relative acceptability of steaks

compared in each test. To facilitate tabulation of ratings, scale points were assigned numerical ratings beginning at the top of the scale, with "Like Extremely" designated as 1 and progressing downward with "Dislike Extremely" as 9.

Results of data thus obtained show that 70 percent of acceptability ratings for all loin steaks fell within 3 categories—"Like Very Much," "Like Moderately," and "Like Slightly." The modal rating for all grades was 3—"Like Moderately." Of the 30 steak ratings of "Dislike Extremely" given by men, Commercial Cow received 57 percent; Good, 27 percent; Standard, 17 percent; and Choice, 0 percent. (Table 7). Mean ratings of the loins by sex of respondent are in grade

TABLE 7--DISTRIBUTION OF RATINGS BY GRADES FOR MEN

Numerical Hedonic Scale Ratings	Choice		Good		Standard		Commercial Cow	
	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent
1	12	5.00	12	2.50	13	2.71	3	1.25
2	52	21.67	97	20.21	87	18.13	31	12.92
3	86	35.83	161	33.54	138	28.75	73	30.42
4	41	17.08	97	20.21	96	20.00	51	21.25
5	16	6.67	50	10.42	58	12.08	22	9.17
6	21	8.75	22	4.58	44	9.17	25	10.42
7	9	3.75	19	3.96	23	4.79	8	3.33
8	3	1.25	14	2.92	16	3.33	10	4.17
9	0	0	8	1.67	5	1.04	17	7.08
N	240		480		480		240	

—ranked order (Table 8). Since differences between mean ratings of men and women are small, a considerable amount of the data in this study was analyzed for men only.

TABLE 8--MEAN RATINGS AND DIFFERENCES IN MEAN RATINGS OF GRADES

Grade	Men			Women			Difference Between Mean Ratings of Men & Women
	Mean Rating*	Differ-ence	Percent Differ-ence**	Mean Rating*	Differ-ence	Percent Differ-ence**	
Choice	3.56			3.36			
		0.14	3.70		0.33	9.00	0.20
Good ₁	3.65			3.79			
Good ₂	3.75			3.59			
Combined	3.70			3.69			
		0.20	5.15		0.19	2.70	0.01
Standard ₁	3.85			3.80			
Standard ₂	3.95			3.97			
Combined	3.90			3.88			
		0.42	9.70		0.40	9.28	0.02
Commercial Cow	4.32			4.28			
Over-all Mean	3.85			3.80			0.05

* Weighted Mean

** Difference was computed as a percentage of the larger rating.

The spread of mean ratings for Choice and Good loins was 1.29 and 1.54 respectively. For Standard and Commercial Cow the spread was 3.37 and 3.08, respectively. These data, shown in Table 9 add support to the contention that the acceptability of the lower grades is more variable than that of the higher grades.

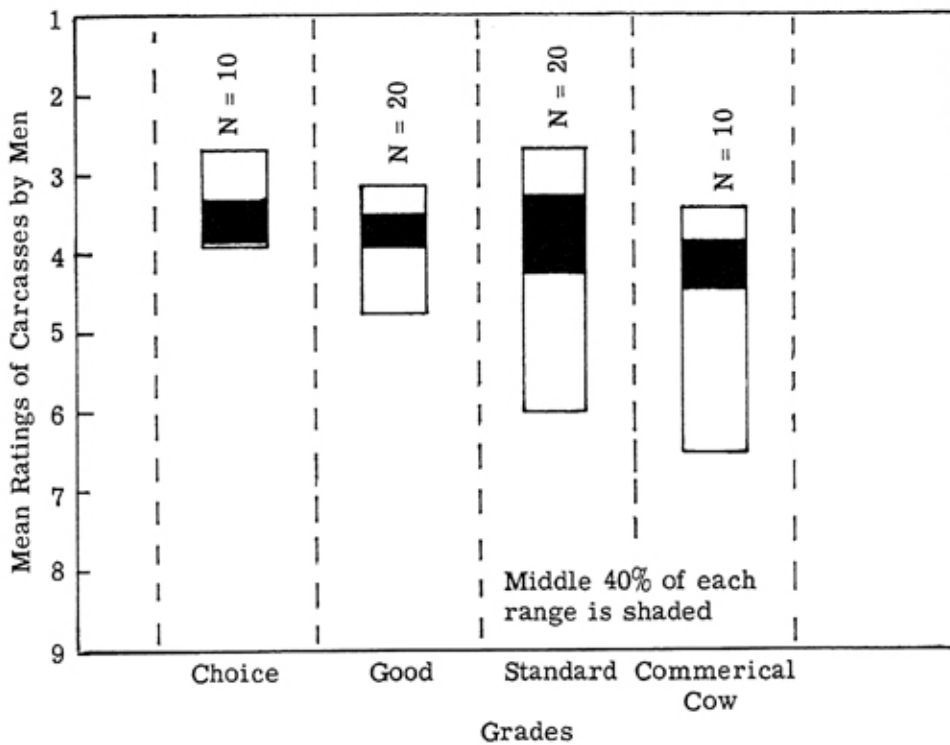
TABLE 9--MEAN RATINGS OF CARCASSES BY GRADES BY MEN

Choice		Good		Standard		Commerical Cow	
Carcass Number	Rat- Rank ing	Carcass Number	Rat- Rank ing	Carcass Number	Rat- Rank ing	Carcass Number	Rat- Rank ing
4	2 2.96	3	16 3.96	2	14 4.25	33	9 5.58
8	8 3.92	5	3 3.29	20	20 6.00	47	5 4.00
12	3 3.13	6	13 3.79	38	5 3.08	48	8 4.50
26	10 3.96	11	5 3.33	44	1 2.63	49	1 3.42
27	6 3.54	15	1 3.17	46	16 4.67	60	3 3.46
28	4 3.33	16	18 4.21	56	3 2.96	61	1 3.42
29	1 2.67	17	17 4.04	57	18 5.00	64	4 3.83
30	7 3.88	21	6 3.46	58	8 3.29	65	6 4.08
35	4 3.33	23	20 4.71	59	9 3.83	67	7 4.42
37	8 3.92	43	8 3.54	63	9 3.83	68	10 6.50
		7	3 3.29	1	2 2.67		
		9	12 3.75	32	19 5.17		
		10	7 3.50	39	7 3.25		
		13	8 3.54	45	17 4.79		
		14	8 3.54	50	12 4.00		
		18	14 3.88	51	15 4.50		
		19	19 4.25	52	5 3.08		
		22	2 3.25	55	4 3.04		
		24	11 3.63	62	13 4.04		
		36	14 3.88	66	11 3.96		
Mean Grade Rating	3.56		3.70		3.90		4.32
Range	2.67-3.96		3.17-4.71		2.63-6.00		3.42-6.50
Spread	1.29		1.54		3.37		3.08

The poorest Choice loin received a mean rating of 3.96 (Table 9 and Figure 6). Percentages of loins in the leaner grades with poorer ratings than 3.96 were Good, 20; Standard, 45; and Commercial Cow, 60. The best rating of any loin was for Standard No. 44 with a mean of 2.63. The same large overlapping of grades and the same general relationship of grade to acceptability is indicated as in the St. Louis experiment.¹ Over-all rating means of grades were quite close with a noticeable break between Standard and Commercial Cow. The whole distribution of ratings was very similar to that of the St. Louis study except that the top of the distribution was a little lower. For example, 14 of the 63 Choice in St. Louis had better mean ratings than the best Choice loin in this study.

Preference and Grade. Through the omission of a "no-preference" answer category, Part II of the evaluation schedule was designed to force the respondent to state a preference for one steak over another. Despite this precaution, 40 answers of "no preference" were received. Some were due to the failure of respondents either to discern a difference in the steaks or to express a preference in case of a recognized difference. Missing data were responsible for other such answers.

FIG. 6—LOIN RATINGS BY GRADE.



Mean percentages of respondent preferences (men and women) were greater for the higher grade in each grade comparison except Good₁—Standard₁ (Table 10). Maximum difference in preferences was 33 percent in favor of Good₂ in the Good₂—Commercial Cow comparison, followed by a 25 percent difference in favor of Choice in the Choice—Standard₂ comparison, and only a 1 percent margin for Standard₁ in the Good₁—Standard₁ grouping.

TABLE 10--PREFERENCES* BY GRADE

Comparison	Percent Preferring		
	First Grade	Second Grade	No Preferences
Good ₁ -Standard ₁	46.2	47.1	6.7
Choice-Standard ₂	60.4	35.8	3.8
Good ₂ -Commercial Cow	65.0	31.9	3.1

* Includes preferences of all respondents.

Three carcasses were preferred in all 12 tests by all persons eating them (Table 3). Twenty loins of the 60 each received 75 percent or more of the 24 preferences expressed per pair (Table 11). The popularity of loins as shown by number of preferences was fairly equal by grades for all comparisons except Good₂ and Commercial Cow. Only 1 of the 20 Commercial Cow loins received more preferences than the corresponding Good₂ loin.

TABLE 11--PREFERENCES FOR LOINS BY GRADES

Comparisons	Gd ₁ & Std ₁		Ch & Std ₂		Gd ₂ & Co. C.		Totals
	Gd ₁	Std ₁	Ch	Std ₂	Gd ₂	Co. C.	
I. No. of loins receiving 18 or more of the 24 preferences	3	2	7	1	7	0	20
II. No. of loins receiving more preferences than other loin of pair (includes I. above)	7	11	11	9	17	1	56
III. No. of loins with preferences evenly divided	2		0		2		4

To estimate the relation between preferences and acceptability, the mean differences in acceptability were computed for the 20 pairs with 75 percent or more preferences for one loin. These means ranged from 0.05 to 3.04 with a median of 1.04 and an over-all mean of 1.29. For all 60 pairs, a difference of 1.39 was found between the mean ratings of all steaks preferred and the mean rating of all steaks not preferred.

The relatively small differences in general between Choice, Good, and Standard and the larger difference between them and Commercial Cow are shown by both the acceptability and preference data. Since the preference data is more subject to the influence of chance pairings, the mean acceptability data for loins is probably the most useful comparison. In any case the relative inferiority of almost all Commercial Cows loins is evident.

There was a slight bias in favor of the no-ring samples. Preference percentages were 49.4 for no-ring and 44.9 for ring by the men and 52.2 and 44.5 by the women.

Acceptability and Preference Related to Shear

Acceptability. Greatest heterogeneity of ratings occurred in the shear groupings beyond 18 pounds. The range in ratings for each shear grouping became progressively wider as the shear values of the carcass increased. It is noteworthy that the group classified "14 to 17.9 pound shear," made up of 29 carcasses, had a narrower range of ratings than the highest shear group ("22 pounds and over"), with one-fifth as many carcasses (Table 12).

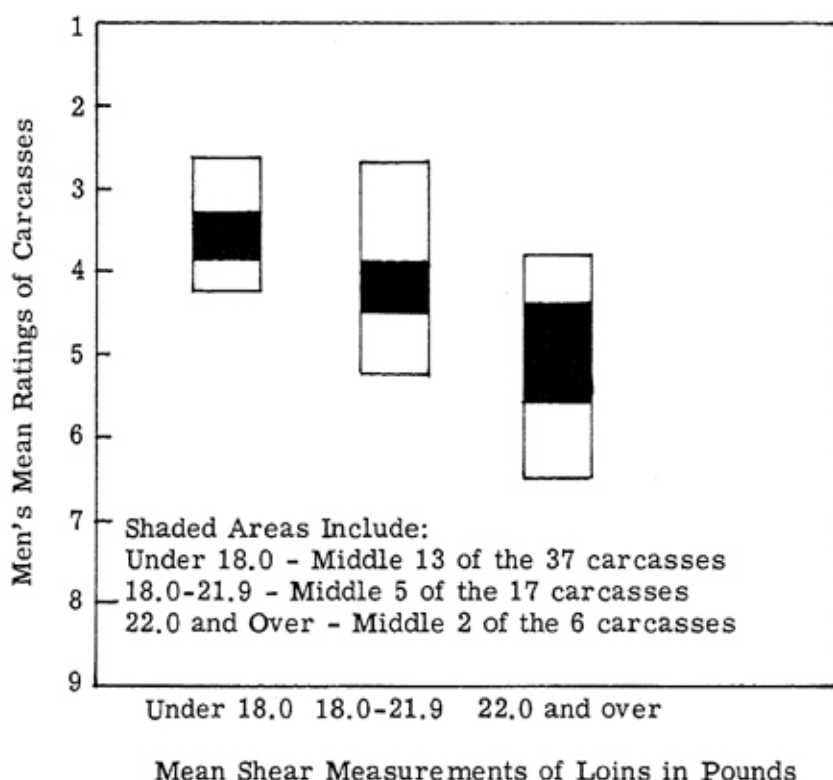
Observation of the loin means and the mean of the mean ratings in each shear group leads to the conclusion that shear groupings were as functional for classifying carcasses as were the federal grades. The mean ratings for the shear groups were progressively poorer as the shear values increased, with a rating of 3.50 for the shear class under 18.0 pounds and 5.19 for the highest shear class (Figure 7). Of the loin means with ratings of 4.00 or better, 79 percent were in the 2 shear categories below 18 pounds, while only 19 percent of the loin means

TABLE 12--MEN'S MEAN RATINGS OF CARCASSES BY SHEAR GROUPS

Shear Measurement in Pounds											
Under 14.0 Pounds			14 to 17.9 Pounds			18 to 21.9 Pounds			22 Pounds and Over		
Carcass	Shear	Rating	Carcass	Shear	Rating	Carcass	Shear	Rating	Carcass	Shear	Rating
	(Choice)			(Choice)			(Choice)			(Standard)	
37	12.61	3.92	12	14.14	3.13	35	18.08	3.33			
			29	14.36	2.67	26	18.19	3.96	20	24.44	6.00
			04	15.22	2.96	30	20.89	3.88	45	25.83	4.79
			27	15.83	3.54						
			28	16.61	3.33						
			08	17.75	3.92						
	(Good)			(Good)			(Good)			(Commercial Cow)	
05	12.89	3.29				43	18.22	3.54			
21	13.19	3.46	10	14.42	3.50	13	19.17	3.54	33	22.28	5.58
			14	14.58	3.54	22	19.92	3.25	64	22.72	3.83
	(Standard)		36	14.64	3.88	19	20.61	4.25	68	23.91	6.51
38	11.14	3.08	18	14.81	3.88	23	21.22	4.71	67	28.14	4.42
44	11.69	2.63	17	14.97	4.04						
52	13.00	3.08	16	15.53	4.21		(Standard)				
39	13.17	3.25	03	15.64	3.96	01	18.11	2.67			
58	13.31	3.29	06	15.67	3.79	57	19.47	5.00			
			09	15.89	3.75	02	19.89	4.25			
			07	16.00	3.29	46	20.11	4.67			
			15	16.03	3.17	51	20.86	4.50			
			24	16.83	3.63	32	21.25	5.17			
			11	17.44	3.33						
				(Standard)			(Commercial Cow)				
			63	14.70	3.83	48	18.36	4.50			
			56	15.03	2.96	47	18.83	4.00			
			50	15.06	4.00	65	21.14	4.08			
			59	15.33	3.83						
			66	15.64	3.96						
			62	15.97	4.04						
			55	16.72	3.04						
				(Commercial Cow)							
			49	15.06	3.42						
			60	15.64	3.46						
			61	17.53	3.42						

Means											
(N = 8)	12.63	3.25	(N = 29)	15.62	3.57	(N = 17)	19.67	4.08	(N = 6)	24.55	5.19
Range		2.63-3.92			2.67-4.21			2.67-5.17			3.83-6.50
Spread		1.29			1.54			2.50			2.67

FIG. 7—LOIN RATINGS BY SHEAR GROUP.



rating above 4.00 were in those categories.

The simple coefficient of correlation of mean shear value and mean ratings of carcasses was 0.68 (95% confidence limits of 0.51 and 0.79), indicating a definite positive correlation between the two. Thus as mean shear values increased, the mean ratings increased (an indication of poorer quality).

Preference. There was a direct relationship between shear and preference. In 44 of 60 loin pairings a majority of preferences were expressed for loins with the lower shears (Table 13). Preferences in 4 other loin pairings were equally divided.

Preferences for the lower shear and higher shear of the loin pairs were computed for 3 groups as follows:

1. Shear of fatter or higher grade was more than 2.0 pounds higher than

TABLE 13--RELATIONSHIP OF SHEAR DIFFERENCE TO PREFERENCES

House-holds #	Loins #	Shear Difference*	Pref. for Lower Shear	Pref. for Higher Shear	No Pref.	House-holds #	Loins #	Shear Difference	Pref. for Lower Shear	Pref. for Higher Shear	No Pref.
<u>Good₁-Standard₁</u>											
	S ₁ G ₁						S ₁ G ₁				
01 & 33	01 & 05	5.22	13	10	1	01 & 33	52 & 05	0.11	8	16	
04 & 35	55 & 15	0.69	6	14	4	04 & 35	01 & 15	2.08	6	16	2
13 & 38	45 & 16	10.30	11	11	2	13 & 38	66 & 16	0.11	7	14	3
14 & 40	32 & 17	6.28	18	5	1	14 & 40	50 & 17	0.09	11	11	2
15 & 43	50 & 23	-6.16	14	10		15 & 43	45 & 23	4.61	17	7	
20 & 51	62 & 06	0.30	9	15		20 & 51	55 & 06	1.05	5	19	
21 & 52	51 & 21	7.67	19	1	4	21 & 52	39 & 21	-0.02	13	9	2
23 & 53	52 & 11	-4.44	21	3		23 & 53	51 & 11	3.42	17	5	2
24 & 56	39 & 43	-5.05	15	8	1	24 & 56	32 & 43	3.03	24	--	
28 & 59	66 & 03	0	6**	12**	6	28 & 59	62 & 03	0.33	15	7	2
<hr/>											
<u>Good₂-Commercial Cow</u>											
	C.C. G ₂						C.C. G ₂				
03 & 36	33 & 14	7.70	20	3	1	03 & 36	33 & 13	3.11	20	4	
05 & 37	49 & 13	-4.11	14	10		05 & 37	49 & 10	0.64	12	12	
10 & 41	65 & 10	6.72	15	7	2	10 & 41	65 & 14	6.56	18	2	4
11 & 42	61 & 19	-3.08	10	12	2	11 & 42	61 & 09	1.64	13	11	
12 & 44	60 & 22	-4.28	8	15	1	12 & 44	60 & 18	0.83	17	7	
16 & 47	68 & 18	9.10	21	3		16 & 47	68 & 19	3.30	18	5	1
22 & 54	47 & 07	2.83	16	6	2	22 & 54	47 & 24	2.00	15	7	2
26 & 55	48 & 24	1.53	13	11		26 & 55	48 & 07	2.36	17	7	
29 & 57	64 & 36	8.08	14	10		29 & 57	64 & 22	2.80	12	12	
30 & 58	67 & 09	12.25	18	6		30 & 58	67 & 36	13.50	16	4	4

TABLE 13--CONTINUED

House- holds #	Loins #	Shear Differ- ence*	Pref. for Lower Shear	Pref. for Higher Shear	No Pref.	House- holds #	Loins #	Shear Differ- ence	Pref. for Lower Shear	Pref. for Higher Shear	No Pref.
Standard ₂ -Choice											
	S ₂ Ch.						S ₂ Ch.				
02 & 31	02 & 12	5.75	22	1	1	02 & 31	02 & 35	1.81	18	6	
06 & 32	56 & 35	-3.05	14	9	1	06 & 32	56 & 27	-0.80	18	6	
07 & 34	46 & 29	5.75	24	--		07 & 34	46 & 26	1.92	20	2	2
08 & 39	63 & 30	-6.19	5	19		08 & 39	63 & 04	-0.52	17	7	
09 & 45	57 & 37	6.86	16	6	2	09 & 45	57 & 08	1.72	13	9	2
17 & 46	20 & 04	9.22	24	--		17 & 46	20 & 30	3.55	23	1	
18 & 48	58 & 26	-4.88	14	10		18 & 48	58 & 29	-1.05	13	10	1
19 & 49	38 & 28	-5.47	16	7		19 & 49	38 & 37	-1.47	7	17	
25 & 50	59 & 27	-0.50	12	11	1	25 & 50	59 & 28	-1.28	4	15	5
27 & 60	44 & 08	-6.06	13	10	1	27 & 60	44 & 12	-2.45	13	10	1

* Minus value (-) indicates that second grade had the higher shear.

** Six Preferences for #03; twelve for #66.

shear of leaner or lower grade. There were 12 pairs in this group and there were 157 preferences for the lower shear and 123 for the higher shear.

2. Differences in shears of pair were zero, plus or minus 2.0 pounds or less. There were 22 pairs with positive or negative differences. There were 266 preferences for the lower shear and 236 for the higher shear. One pair had a zero difference in shears.
3. Shear of fatter or higher grade was more than 2.0 pounds lower than shear of leaner or lower grade. Of these 25 pairs, there were 441 preferences for the lower shear and 132 preferences for the higher shear.

These data indicate that both a higher grade and/or a lower shear generally received more preferences than a lower grade and/or a higher shear. Pairs involving *both* a higher grade and a lower shear (Group 3) received by far the greatest proportion of preferences. Pairs in which grade and shear were opposed (Group 1: the higher loin had the higher shear) had a more nearly equal division of preferences. However, the lower grade and lower shear loins had more preferences than the higher grade and higher shear loins in Group 1, which suggests the relative importance of grade and shear (Figure 8). The pairs of loins with very small shear differences (Group 2) had preferences about evenly divided between higher and lower grades—263 and 257, respectively, but had a slight majority of preferences for the lower shears—266 to 236. A total of 63.8 percent of preferences was for the lower shear loins and 36.2 percent was for the higher shear loins (excluding no preferences and the loin pair with no difference in shear).

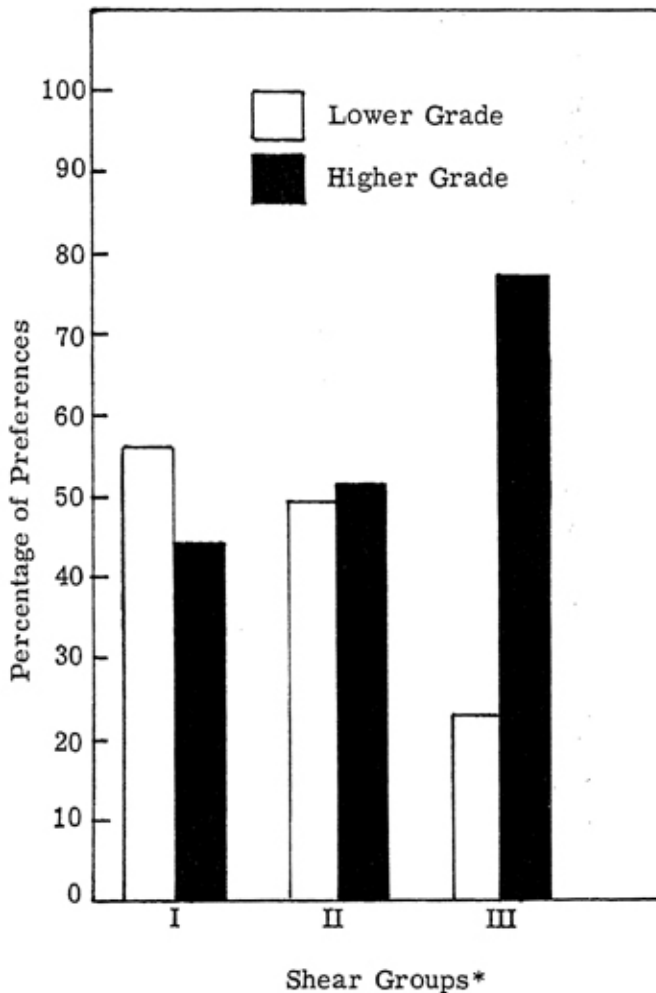
Researchers customarily identify experimental beef products by carcass grade and weight. These results emphasize the importance of adding shear as another identifying characteristic.

It should be noted that a majority of preferences for a few exceptional pairs were for loins of both higher shear and lower grade—e.g., loin pairs 61 and 19, 60 and 22, and 63 and 30. Moreover, the size of the difference in shear between the paired loins was not always proportionately related to preferences. Listed below in Table 14 are a few examples taken from Table 13.

TABLE 14--SHEAR AND PREFERENCE DIFFERENCES

Grade	Shear Difference	Preference for Lower Shear	Preference for Higher Shear	No Preference
Gd ₁ -Std ₁	0.11	8	16	
Std ₂ -Ch.	5.75	22	1	1
Gd ₂ -C. Cow	8.08	14	10	
Gd ₁ -Std ₁	10.30	11	11	2
Gd ₂ -C. Cow	12.25	18	6	
Gd ₂ -C. Cow	13.50	16	4	4

FIG. 8—PREFERENCES FOR GRADES IN PAIRED COMPARISONS.

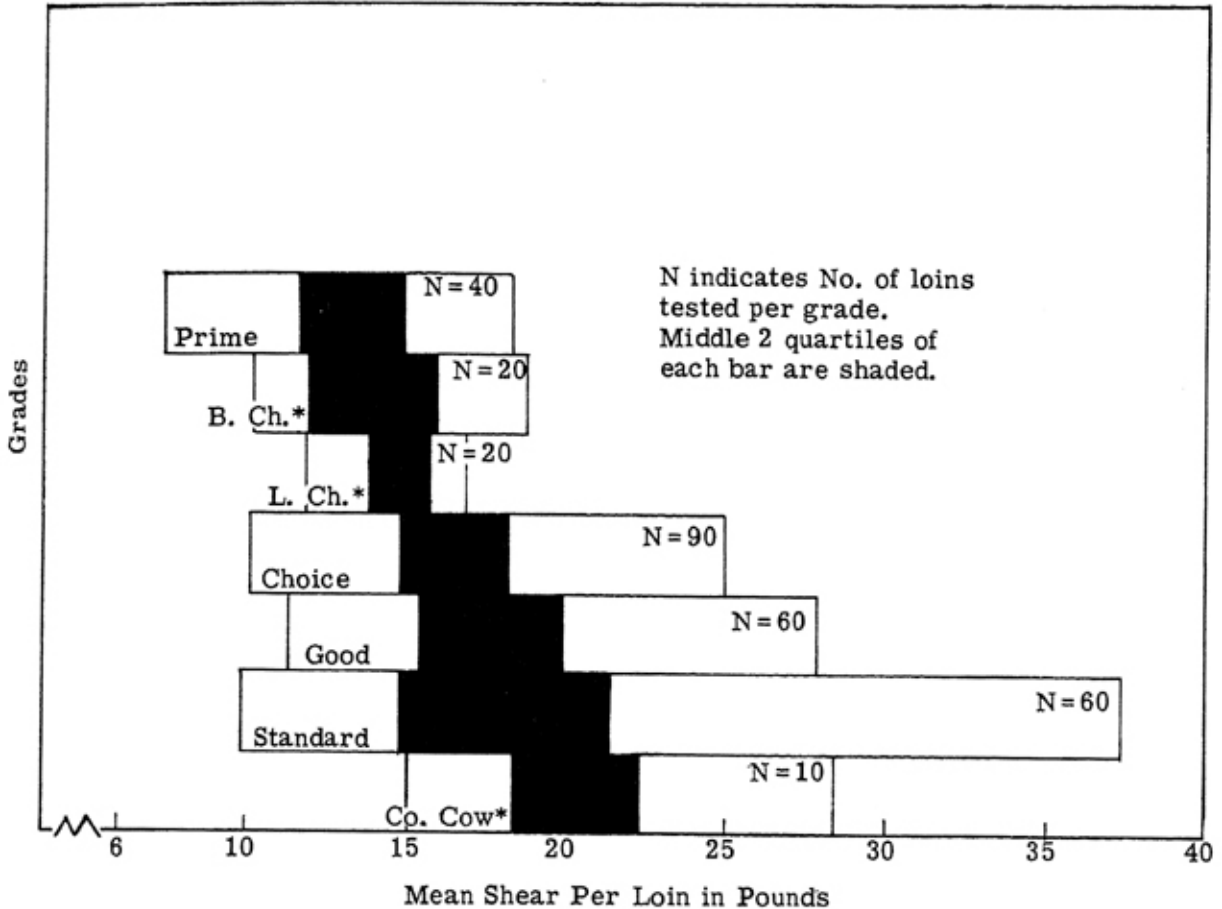


- * I Lower grade had lower shear by 2.0 pounds or more
 II Shear differences by grade of \pm 2.0 pounds or less
 III Lower grade had higher shear by 2.0 pounds or more

Relationship of Shear and Grade.

The fair relationship found between shear and acceptability in this experiment and the St. Louis experiment¹ indicates the usefulness of examining the relationship of shear and grade. Therefore, the relationship found for 300 short loins in three major studies will be summarized here. Procedures of shearing were much alike and are described in Missouri Research Bulletins 612⁶ and 651¹.

FIG. 9—DISTRIBUTION OF SHEARS BY GRADE, RECENT MISSOURI EXPERIMENTS.



*B. Choice were larger Choice carcasses weighing 650 to 710 pounds; L. Choice were smaller Choice carcasses weighing 480 to 510 pounds; Commercial Cow carcasses weighed 600 to 650 pounds: all other carcasses weighed 550 to 605.

The distribution of mean shears of loins by grades is shown in Figure 9. Doubtlessly, the lengths and nature of each grade's distribution is affected by the number of loins tested and by other variables. However, fairly useful comparisons of the four block grades of beef can be made. The similarities of Good and Choice should be noted. It has been shown that loins with shear weights below 20 pounds are much more likely to be highly acceptable to consumers than loins with shear weights above 20 pounds. Percentages of loins tested with shears exceeding 20 pounds were Choice (550-605 pound carcasses), 11; Good, 23; Standard, 33; and Commercial Cow, 50.

Acceptability and Cooking Method

Although strict adherence to cooking method and degree of doneness was stressed, three of the 60 households changed method and 14 changed degree of doneness during the study. Degree of doneness different than the ordinary were reported for 2.5 percent of the tests. Overall, broiling was more than twice as popular as pan frying, the other cooking method used often (Table 15). About 68 percent of the steaks were cooked well done (Table 16).

TABLE 15--PERCENTAGE OF HOUSEHOLD REPORTING METHOD USED IN COOKING TEST STEAKS BY GRADE COMPARISONS

Cooking Method	Grade Comparisons			Total
	Choice - Standard ₂	Good ₁ - Standard ₁	Good ₂ - C. Cow	
	%	%	%	%
Broil	65	55	65	62
Pan-Fry	35	35	20	30
Other	--	5	5	3
Changed Method	--	5	10	5
No. Households	20	20	20	60

TABLE 16--DEGREE OF DONENESS BY COOKING METHODS

Method of Cooking	Degree of Doneness			
	Well		Rare	
	No. of Families	Percentage	No. of Families	Percentage
Broil	23	62	14	38
Pan-Fry and Others	18	78	5	22

Socio-Economic Factors and Acceptability

Table 17 shows mean ratings of carcasses by grade according to age and education. In no particular age group were the ratings in grade-ranked order. No relationship was apparent between respondent age and acceptability. This lack of relationship is not surprising in view of the intra-grade heterogeneity.

Examination of mean ratings of carcasses by men at various levels of educational attainment indicated no consistent direct relationship of acceptability and education.

Socio-Economic Factors, Cooking Methods and Doneness

Method of cooking was related to age, education, and income of families. Broiling was utilized twice as frequently as pan-frying, overall. However, broiling was proportionately a little more prevalent among those of less education, lower incomes, and lower ages. For example, of those who broiled, 39 percent were in their 20's (average age of husband and wife) while only 16 percent of those who pan-fried were in their 20's. Of those who broiled 44 percent were in the lowest income bracket (less than \$4000) while only 21 percent of those who pan-fried were in that bracket.

TABLE 17--MEAN RATINGS OF CARCASSES BY GRADE ACCORDING TO COOKING
METHOD AND SOCIO-ECONOMIC FACTORS

Grade	Cooking Method		Average Age of Couple in Years				Education of Men		
	Broiled	Fried & Other	20's	30's	40's	50's & Over	High School Grad. or Less	Some Train- ing Beyond High School	One of More College Degrees
Choice	3.70	3.01	3.77	3.43	3.02	3.38	2.88	3.42	3.57
Good ₁	3.84	3.64	3.90	3.76	3.73	3.00	3.87	3.82	3.58
Good ₂	3.92	3.20	3.04	3.92	3.04	5.17	3.97	3.34	3.81
Good Combined	3.88	3.42	3.47	3.84	3.38	4.08	3.92	3.58	3.70
Standard ₁	3.70	4.03	3.88	3.77	3.93	4.00	3.80	3.81	3.93
Standard ₂	4.15	3.58	4.13	4.32	3.12	3.71	4.38	4.17	3.80
Standard Combined	3.92	3.80	4.00	4.04	3.52	3.86	4.09	3.99	3.86
Commercial Cow	4.46	4.60	3.57	4.80	3.00	6.12	4.56	3.64	4.84
Mean Rating (All Grades)	3.92	3.62	3.72	4.00	3.31	4.23	3.91	3.70	3.92

Degree of doneness was definitely related to income. Of those who cooked loin steaks rare, 51 percent were in the top income bracket (\$6000 and more), while 30 percent of those who cooked well-done were in that bracket. The more educated cooked rare slightly more frequently. There was no consistent relation of degree of doneness to age in the sample.

Socio-Economic Factors and Preferences

Preferences were not examined in relation to socio-economic characteristics of the respondents except in the attempt to determine preference strength by the "Mean Price Difference" approach. This method utilized the respondents answer to the question, "How much more per pound do you think you would be willing to pay for the steak you like best?" The price differential thus obtained was then interpreted as the quality differential observed by the respondent. This procedure is necessarily limited; at best both it and its interpretation are simply opinions.

Supposedly the greater the mean price difference, the stronger the preference for one of the steaks in the package. Strongest preferences were indicated by women with the lowest level of educational attainment in the middle-income group. Weakest preferences were indicated in the low-income group by the women with some training beyond high school. Those in the high-income group indicated relatively uniform strength of preferences regardless of educational attainment. Similarly those with one or more college degrees indicated reasonably uniform strength of preferences irrespective of level of income.

Respondents were willing to pay an average of 4.9¢ more per pound for the steaks they liked best in the comparisons. Seven families even indicated a willingness to pay more than 20¢ more per pound for their choice of steaks. Much of the time a zero differential was indicated by many families. These results were obtained in a hypothetical situation and cannot be inferred directly to market situations. The common feeling appeared to be that one bought "good steak" at the market price and, as a buyer, had no choice between "good steak" and other steak known to be a certain degree better or poorer.

LABORATORY EVALUATION

Two trios by each of six judges were run between the same comparisons as the left loins tasted by consumers.†† Sufficient product was not available to test the right loin comparisons. Although these left loin comparisons generally had larger shear differences, there were only 13 of the 30 pairs with significant trio discriminations (Table 18). Only 5 of these 13 pairs also had significant consumer preference ratios, while there were 5 other pairs which had significant consumer preference ratios but not significant laboratory discrimination. Thus the level of discrimination was approximately the same by both consumers and the laboratory judges, but there were some differences in the particular pairs dis-

††Laboratory Panel procedure described in Appendix.

TABLE 18--LOIN COMPARISONS WITH SIGNIFICANT JUDGE DISCRIMINATIONS IN LABORATORY TESTS

Choice-Standard ₂	Good ₁ -Standard ₁	Good-Commercial Cow
37 & 57	21 & 51*	36 & 64
35 & 56	11 & 52*	07 & 47
30 & 63*	15 & 55	
08 & 44	16 & 45	
04 & 20*		
29 & 46*		
26 & 58		

* These pairs had significant consumer preferences ratios also.

criminated between. Somewhat the same comparative results were found in the St. Louis study.⁴

Three steaks from each carcass were used for trios, and two steaks were evaluated by six judges on the basis of tenderness, juiciness and flavor. The range in mean ratings by grade and shear are indicated in Figures 10 and 11. The comparisons of one characteristic with another are complicated by scale differences. Tenderness was evaluated on an 8-point scale, juiciness on a 5-point and flavor on a 9-point. In all cases the higher (smaller the number) the score, the more desirable the rating. The superiority of shear over grade in differentiating loins by tenderness and flavor is clearly evident.

A rather interesting test of methodology was attempted in the laboratory panel. During the first half of the panel (one steak of each loin) three judges evaluated tenderness and juiciness while three other judges evaluated flavor only. Each judge was in the group evaluating flavor for one half of the steaks and in the other group for the other half of the steaks. Coefficients of simple correlation between individual ratings were tenderness—juiciness, 0.48; tenderness—flavor, 0.28; and juiciness—flavor, 0.20. During the second half of the panel (one steak of each loin) all six judges evaluated all three characteristics. Coefficients of simple correlation between individual ratings were tenderness—juiciness, 0.32; tenderness—flavor, 0.37; and juiciness—flavor, 0.34. These results suggest that evaluation of separate sensory characteristics by separate judges reduces the "halo" or the inter-relationship among ratings. The data are too small to be anything more than suggestive, but further tests would appear worthwhile.

Loin means for each characteristic were correlated with consumer mean ratings. Coefficients are shown in Table 19. The tenderness-consumer correlation

TABLE 19--COEFFICIENTS OF CORRELATION OF LABORATORY AND CONSUMER PANEL MEAN RATINGS

	Replicate I	Replicate II	Replicate I & II Weighted Mean
Lab Tenderness -			
Consumer Mean	0.614	0.683	0.674
Lab Juiciness -			
Consumer Mean	0.324	0.343	0.421
Lab Flavor -			
Consumer Mean	0.261	0.579	0.560

FIG. 10—RANGE IN ACCEPTABILITY BY GRADES, LABORATORY EVALUATIONS.

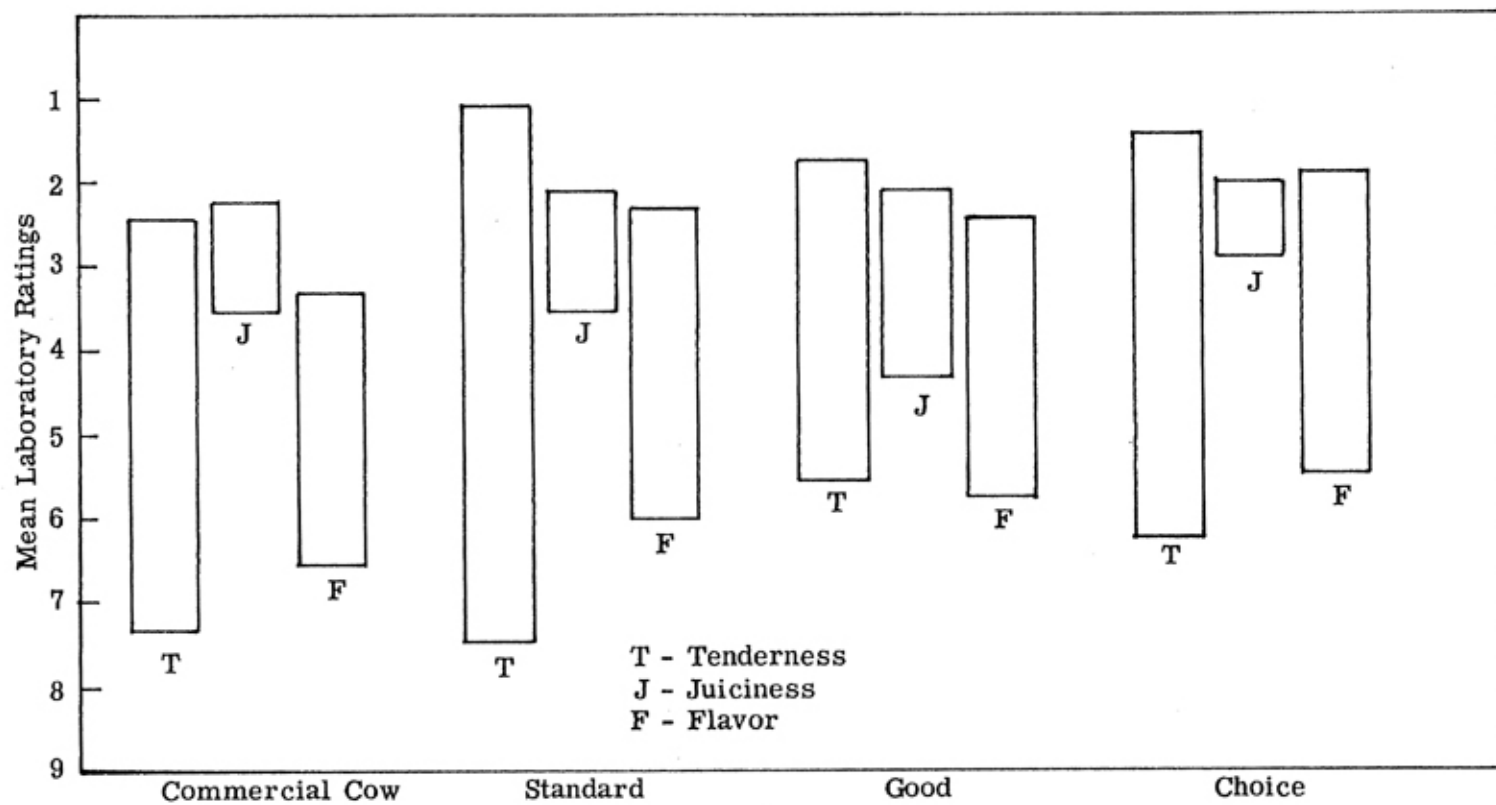
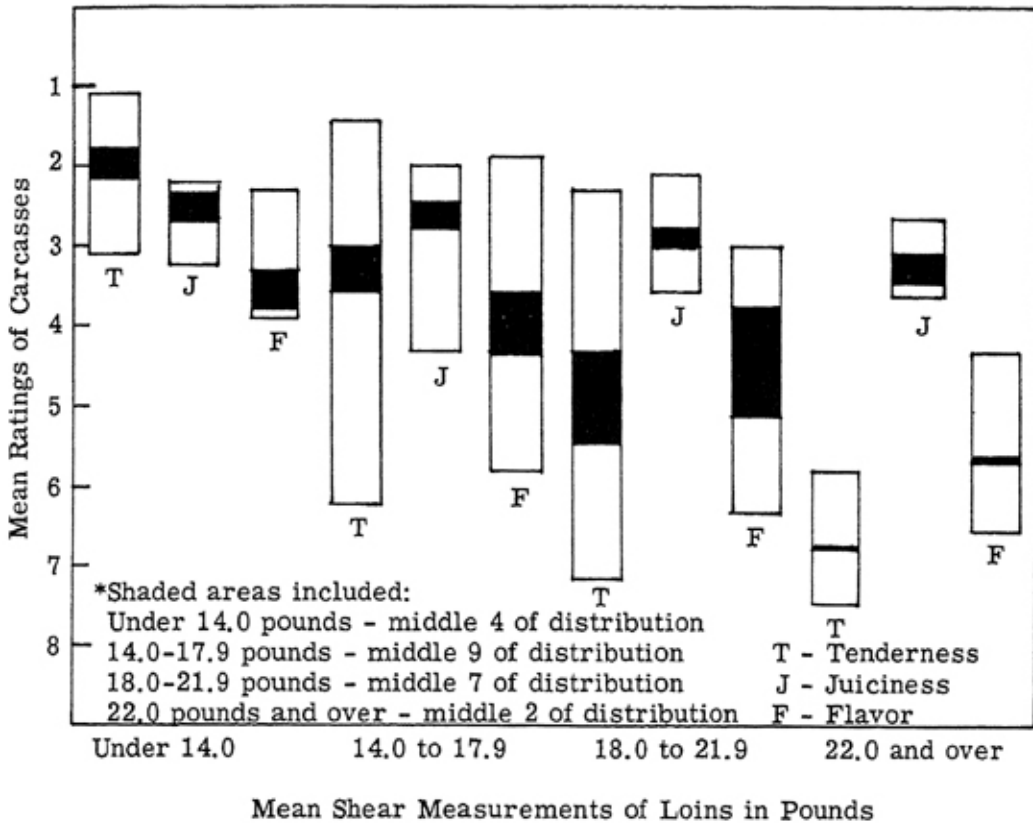


FIG. 11—LABORATORY RATINGS OF TENDERNESS, JUICINESS AND FLAVOR BY SHEAR GROUP.



and the flavor-consumer correlation were fairly high. It would appear possible that longer and more thorough laboratory tasting by a well-trained panel plus consumer tasting of each loin by as many families as possible (to average out individual idiosyncrasies in ratings) might provide a very useful relationship between laboratory and consumer panel results. It would appear better to separate evaluation of the characteristics to reduce "halo." It is possible that the flavor-consumer coefficient for the second replicate is partly spurious because of the inter-correlation of tenderness and flavor.

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APPENDIX

Laboratory Panel Procedure

Three male and three female students each tasted 5 steak trios per day. Three bite size servings were tasted each time in individual, darkened booths, and the judge attempted to indicate the different sample. Water was available for sipping between tastings. Judges were trained for eight days preceding the tests.

Steaks were cooked on a commercial grill with thermostats set at 300 degrees F and preheated for 30 minutes. Steaks were cooked a total of eleven minutes and were turned at five minutes. Only lean portions were served.

Palatability Evaluation

Six panel members tasted ten steaks each session and evaluated each for tenderness, juiciness and flavor. Scales used were as shown in Figure 12. Ten steaks were tasted each session with all six judges evaluating bites from each steak.

Cooking procedures were the same as above except that steaks were turned at six minutes and were cooked a total of 15 minutes.

Tasting was in individual, darkened booths. A training period of three days preceded the tests.

One steak from each of the 60 loins was evaluated in a randomized order and then the second steak from each of those same loins was evaluated in the same order. Hedonic ratings were assigned numerical values of 1 to 8, 1 to 9, and 1 to 5, respectively, in analyzing the evaluations of tenderness, flavor, and juiciness.

FIG. 12—LABORATORY RATING SCALES.

Flavor Quality Ratings

Extremely Poor	Very Poor	Poor	Below Fair Above Poor	Fair	Below Good Above Fair	Good	Very Good	Excellent

Toughness - Tenderness Rating

Extremely Tough	Very Tough	Moderately Tough	Slightly Tough	Slightly Tender	Moderately Tender	Very Tender	Extremely Tender

Juiciness Rating

No Juiciness	Slight Juiciness	Moderate Juiciness	Much Juiciness	Extreme Juiciness

TABLE 20--DETAILED RATING DATA BY HOUSEHOLDS

Household	Carcass	N	Mean Rating
01	01	6	3.00
01	05	12	2.83
01	52	6	2.66
33	01	6	3.50
33	05	12	3.75
33	52	6	3.83
04	01	6	2.00
04	15	12	3.33
04	55	6	3.00
35	01	6	2.16
35	15	12	3.00
35	55	6	3.66
13	16	12	3.83
13	45	6	4.50
13	66	6	2.66
38	16	12	4.58
38	45	6	4.50
38	66	6	4.50
14	17	12	3.58
14	32	6	5.33
14	50	6	4.16
40	17	12	4.50
40	32	6	5.16
40	50	6	4.50
15	23	12	5.83
15	45	6	5.83
15	50	6	4.50
43	23	12	3.58
43	45	6	4.33
43	50	6	2.83
20	06	12	3.50
20	55	6	2.50
20	62	6	2.50
51	06	12	4.08
51	55	6	2.50
51	62	6	4.83
21	21	12	3.08
21	39	6	3.00
21	51	6	4.83
52	21	12	3.83
52	39	6	3.00
52	51	6	5.16
23	11	12	3.58
23	51	6	4.16
23	52	6	2.83

TABLE 20--CONTINUED

Household	Carcass	N	Mean Rating
17	04	6	2.83
17	20	12	5.66
17	30	6	2.50
46	04	6	2.33
46	20	12	6.33
46	30	6	3.66
18	26	6	4.83
18	29	6	3.83
18	58	12	3.50
48	26	6	3.66
48	29	6	2.50
48	58	12	3.08
19	28	6	3.33
19	37	6	4.16
19	38	12	3.25
49	28	6	2.83
49	37	6	3.00
49	38	12	2.91
25	27	6	3.66
25	28	6	3.83
25	59	12	4.33
50	27	6	4.00
50	28	6	3.33
50	59	12	3.33
27	08	6	3.16
27	12	6	2.83
27	44	12	2.25
60	08	6	2.50
60	12	6	3.33
60	44	12	3.00
03	13	6	4.50
03	14	6	5.00
03	33	12	6.16
36	13	6	2.66
36	14	6	3.16
36	33	12	5.00
05	10	6	3.33
05	13	6	3.00
05	49	12	3.08
37	10	6	3.83
37	13	6	4.00
37	49	12	3.75
10	10	6	3.33
10	14	6	2.33
10	65	12	4.25

TABLE 20--CONTINUED

Household	Carcass	N	Mean Rating
53	11	12	3.08
53	51	6	3.83
53	52	6	3.00
24	32	6	5.50
24	39	6	4.16
24	43	12	4.33
56	32	6	4.66
56	39	6	2.83
56	43	12	2.75
28	03	12	3.00
28	62	6	5.16
28	66	6	2.83
59	03	12	4.91
59	62	6	3.66
59	66	6	5.83
02	02	12	4.50
02	12	6	3.83
02	35	6	3.83
31	02	12	4.00
31	12	6	2.50
31	35	6	2.66
06	27	6	3.33
06	35	6	3.66
06	56	12	3.00
32	27	6	3.16
32	35	6	3.16
32	56	12	2.91
07	26	6	3.33
07	29	6	2.83
07	46	12	4.08
34	26	6	4.00
34	29	6	1.50
34	46	12	5.25
08	04	6	3.00
08	30	6	2.50
08	63	12	3.25
39	04	6	3.66
39	30	6	6.83
39	63	12	4.41
09	08	6	3.66
09	37	6	2.83
09	57	12	3.91
45	08	6	6.33
45	37	6	5.66
45	57	12	6.08

TABLE 20--CONTINUED

Household	Carcass	N	Mean Rating
41	10	6	3.50
41	14	6	3.66
41	65	12	3.91
11	09	6	3.83
11	19	6	3.83
11	61	12	3.91
42	09	6	3.00
42	19	6	2.83
42	61	12	2.91
12	18	6	4.00
12	22	6	3.33
12	60	12	4.16
44	18	6	2.00
44	22	6	2.66
44	60	12	2.75
16	18	6	2.83
16	19	6	2.50
16	68	12	4.08
47	18	6	6.66
47	19	6	7.83
47	68	12	8.91
22	07	6	3.33
22	24	6	2.83
22	47	12	3.33
54	07	6	2.66
54	24	6	4.66
54	47	12	4.66
26	07	6	4.50
26	24	6	3.83
26	48	12	6.08
55	07	6	2.66
55	24	6	3.16
55	48	12	2.91
29	22	6	4.00
29	36	6	4.16
29	64	12	4.16
57	22	6	3.00
57	36	6	3.50
57	64	12	3.50
30	09	6	2.33
30	36	6	2.33
30	67	12	3.16
58	09	6	5.83
58	36	6	5.50
58	67	12	5.66

TABLE 21--DETAILED RATING DATA BY HOUSEHOLD AND CARCASS

Grade	Carcass No.	Household		Mean	Difference in H. H. Means	Sign. of Diff. in H. H. Means	Standard Deviation
		No.	N				
1 (Good ₁)	03	28	12	3.000			1.537
1	03	59	12	4.916			1.732
1	03		24	3.958	1.92	.01	1.876
1	05	01	12	2.833			0.579
1	05	33	12	3.750			0.868
1	05		24	3.291	0.92	.01	0.859
1	06	20	12	3.500			1.381
1	06	51	12	4.083			1.445
1	06		24	3.791	0.58	N.S.	1.414
1	11	23	12	3.583			0.797
1	11	53	12	3.083			1.566
1	11		24	3.333	0.50	N.S.	1.240
1	15	04	12	3.333			1.436
1	15	35	12	3.000			1.044
1	15		24	3.166	0.33	N.S.	1.240
1	16	13	12	3.833			1.467
1	16	38	12	4.583			2.153
1	16		24	4.208	0.75	N.S.	1.841
1	17	14	12	3.583			1.087
1	17	40	12	4.500			1.000
1	17		24	4.041	0.92	.05	1.122
1	21	21	12	3.083			1.167
1	21	52	12	3.833			1.528
1	21		24	3.458	0.75	N.S.	1.383
1	23	15	12	5.833			2.758
1	23	43	12	3.583			1.732
1	23		24	4.708	2.25	.05	2.528
1	43	24	12	4.333			0.889
1	43	56	12	2.750			1.423
1	43		24	3.541	1.58	.01	1.414
2 (Standard ₁)	01	01	6	3.000			0.632
2	01	04	6	2.000			0.894
2	01	33	6	3.500			1.048
2	01	35	6	2.166			0.761
2	01		24	2.666	1.50	.05	1.008
2	32	14	6	5.333			2.068
2	32	24	6	5.000			1.224
2	32	40	6	5.166			1.174
2	32	56	6	4.666			2.253
2	32		24	5.166	0.84	N.S.	1.660
2	39	21	6	3.000			2.000
2	39	24	6	4.166			1.174
2	39	52	6	3.000			1.095
2	39	56	6	2.833			0.761
2	39		24	3.250	1.33	N.S.	1.359

TABLE 21--CONTINUED

Grade	Carcass No.	Household No.	N	Mean	Difference in H. H. Means	Sign. of Diff. in H. H. Means	Standard Deviation
2	45	13	6	4.500			1.224
2	45	15	6	5.833			2.641
2	45	38	6	4.500			2.738
2	45	43	6	4.333			2.068
2	45		24	4.791	1.47	N.S.	2.186
2	50	14	6	4.166			0.424
2	50	15	6	4.500			2.738
2	50	40	6	4.500			0.547
2	50	43	6	2.833			0.424
2	50		24	4.000	1.67	N.S.	1.503
2	51	21	6	4.833			1.174
2	51	23	6	4.166			1.174
2	51	52	6	5.166			1.944
2	51	53	6	3.833			1.174
2	51		24	4.500	1.33	N.S.	1.414
2	52	01	6	2.666			0.529
2	52	23	6	2.833			0.989
2	52	33	6	3.833			1.726
2	52	53	6	3.000			0.894
2	52		24	3.083	1.17	N.S.	1.140
2	55	04	6	3.500			1.224
2	55	20	6	2.500			1.224
2	55	35	6	3.666			1.216
2	55	51	6	2.500			1.048
2	55		24	3.041	1.16	N.S.	1.233
2	62	20	6	2.500			1.378
2	62	28	6	5.166			0.989
2	62	51	6	4.833			1.944
2	62	59	6	3.666			1.039
2	62		24	4.041	2.66	.05	1.681
2	66	13	6	2.666			0.529
2	66	28	6	2.833			0.761
2	66	38	6	4.500			1.643
2	66	59	6	5.833			1.838
2	66		24	3.958	3.17	.01	1.805
3 (Choice)	04	08	6	3.000			0.632
3	04	17	6	2.833			0.761
3	04	39	6	3.666			1.865
3	04	46	6	2.333			1.039
3	04		24	2.958	1.33	N.S.	1.197
3	08	09	6	3.666			2.163
3	08	27	6	3.166			1.726
3	08	45	6	6.333			0.529
3	08	60	6	2.500			1.048
3	08		24	3.916	3.83	.01	2.041
3	12	02	6	3.833			1.838
3	12	27	6	2.833			0.989

TABLE 21--CONTINUED

Grade	Carcass No.	Household No.	N	Mean	Difference in H. H. Means	Sign. of Diff. in H. H. Means	Standard Deviation
3	12	31	6	2.500			0.547
3	12	60	6	3.333			1.216
3	12		24	3.125	1.33	N.S.	1.263
3	26	07	6	3.333			1.509
3	26	18	6	4.833			0.424
3	26	34	6	4.000			2.756
3	26	48	6	3.666			1.637
3	26		24	3.958	1.50	N.S.	1.756
3	27	06	6	3.333			1.216
3	27	25	6	3.666			1.216
3	27	32	6	3.166			0.761
3	27	50	6	4.000			0.000
3	27		24	3.541	0.84	N.S.	0.932
3	28	19	6	3.333			1.039
3	28	25	6	3.833			1.606
3	28	49	6	2.833			0.424
3	28	50	6	3.333			1.371
3	28		24	3.333	1.00	N.S.	1.168
3	29	07	6	2.833			0.424
3	29	18	6	3.833			1.174
3	29	34	6	1.500			0.836
3	29	48	6	2.500			0.547
3	29		24	2.666	2.33	.01	1.130
3	30	08	6	2.500			0.547
3	30	17	6	2.500			1.643
3	30	39	6	6.833			0.761
3	30	46	6	3.666			0.529
3	30		24	3.875	4.33	.01	2.029
3	35	02	6	3.833			1.838
3	35	06	6	3.666			1.969
3	35	31	6	2.666			0.529
3	35	32	6	3.166			1.476
3	35		24	3.333	1.17	N.S.	1.523
3	37	09	6	2.833			0.424
3	37	19	6	4.166			1.174
3	37	45	6	5.666			1.371
3	37	49	6	3.000			0.894
3	37		24	3.916	2.83	.01	1.502
4 (Standard ₂)	02	02	12	4.500			2.022
4	02	31	12	4.000			0.953
4	02		24	4.250	0.50	N.S.	1.567
4	20	17	12	5.666			1.074
4	20	46	12	6.333			1.615
4	20		24	6.000	0.67	N.S.	1.383
4	38	19	12	3.250			1.217
4	38	49	12	2.916			0.674
4	38		24	3.083	0.34	N.S.	0.975

TABLE 21--CONTINUED

Grade	Carcass No.	House-		Mean	Difference in H. H. Means	Sign. of Diff. in H. H. Means	Standard Deviation
		hold No.	N				
4	44	27	12	2.250			1.358
4	44	60	12	3.000			0.852
4	44		24	2.625	0.75	N.S.	1.173
4	46	07	12	4.083			0.674
4	46	34	12	5.250			2.379
4	46		24	4.666	1.17	N.S.	1.810
4	56	06	12	3.000			1.128
4	56	32	12	2.916			0.797
4	56		24	2.958	0.09	N.S.	0.955
4	57	09	12	3.916			1.445
4	57	45	12	6.083			0.797
4	57		24	5.000	2.17	.01	1.587
4	58	18	12	3.500			1.000
4	58	48	12	3.083			1.167
4	58		24	3.291	0.42	N.S.	1.083
4	59	25	12	4.333			1.498
4	59	50	12	3.333			1.074
4	59		24	3.833	1.00	N.S.	1.373
4	63	08	12	3.250			1.659
4	63	39	12	4.416			2.645
4	63		24	3.833	1.16	N.S.	2.239
5 (Good ₂)	07	22	6	3.333			0.824
5	07	26	6	4.500			1.516
5	07	54	6	2.666			1.039
5	07	55	6	2.666			0.529
5	07		24	3.291	1.84	.05	1.233
5	09	11	6	3.833			2.140
5	09	30	6	2.333			0.529
5	09	42	6	3.000			0.632
5	09	58	6	5.833			2.044
5	09		24	3.750	3.50	.01	1.961
5	10	05	6	3.333			1.216
5	10	10	6	3.333			1.509
5	10	37	6	3.833			1.944
5	10	41	6	3.500			0.547
5	10		24	3.500	0.50	N.S.	1.318
5	13	03	6	4.500			2.345
5	13	05	6	3.000			1.264
5	13	36	6	2.666			1.371
5	13	37	6	4.000			1.897
5	13		24	3.541	1.84	N.S.	1.817
5	14	03	6	5.000			3.286
5	14	10	6	2.333			0.529
5	14	36	6	3.166			1.174
5	14	41	6	3.666			0.529
5	14		24	3.541	2.67	N.S.	1.933

TABLE 21--CONTINUED

Grade	Carcass No.	Household No.	N	Mean	Difference in H. H. Means	Sign. of Diff. in H. H. Means	Standard Deviation
5	18	12	6	4.000			1.549
5	18	16	6	2.833			0.761
5	18	44	6	2.000			0.894
5	18	47	6	6.666			1.371
5	18		24	3.875	4.66	.01	2.113
5	19	11	6	3.833			1.174
5	19	16	6	2.500			1.378
5	19	42	6	2.833			0.761
5	19	47	6	7.833			1.476
5	19		24	4.250	5.33	.01	2.453
5	22	12	6	3.333			1.216
5	22	29	6	4.000			1.673
5	22	44	6	2.666			1.039
5	22	57	6	3.000			1.095
5	22		24	3.250	1.34	N.S.	1.293
5	24	22	6	2.833			0.424
5	24	26	6	3.833			1.334
5	24	54	6	4.666			1.371
5	24	55	6	3.166			0.424
5	24		24	3.625	1.83	.05	1.173
5	36	29	6	4.166			1.944
5	36	30	6	2.333			1.039
5	36	57	6	3.500			0.836
5	36	58	6	5.500			2.073
5	36		24	3.875	3.17	.05	1.873
6 (Com. Cow)	33	03	12	6.166			2.480
6	33	36	12	5.000			2.296
6	33		24	5.583	1.16	N.S.	2.412
6	47	22	12	3.333			0.780
6	47	54	12	4.666			1.557
6	47		24	4.000	1.33	.05	1.383
6	48	26	12	6.083			1.566
6	48	55	12	2.916			0.522
6	48		24	4.500	3.17	.01	1.978
6	49	05	12	3.083			1.381
6	49	37	12	3.750			1.140
6	49		24	3.416	0.67	N.S.	1.283
6	60	12	12	4.166			1.194
6	60	44	12	2.750			1.358
6	60		24	3.458	1.41	.05	1.444
6	61	11	12	3.916			1.314
6	61	42	12	2.916			0.797
6	61		24	3.416	1.00	.05	1.177
6	64	29	12	4.166			1.586
6	64	57	12	3.500			0.904
6	64		24	3.833	0.66	N.S.	1.308