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NATIONAL CONSUMER BEEF STUDY**

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JULY 1985

***Invited Paper, Western Agricultural Economics Association Annual
Meeting, Saskatoon, Canada, July 7-9, 1985.**

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This paper has four objectives. These are (1) to review the causes behind the development of the National Consumer Beef Study, (2) to consider the agricultural economist's role in such research, (3) to review research methodology and results, and (4) to consider their possible implications for changes in the beef marketing structure. The research, carried to its conclusion, will cost near one million dollars. It is not unique in that regard. The dairy industry is presently making a comparable outlay to analyze consumer markets. The Florida citrus industry has steadily invested in such research. Coca Cola reportedly spent four million dollars researching a change in its lead product — Coca Cola. Scanner panel market data from one small test market costs approximately two hundred thousand dollars per year.¹ In these endeavors, product evaluation and market organization and strategy are both targets.

Agricultural producer check-off programs are increasing, a precursor to funding such national level research. Although such market information is costly, agricultural economists increasingly need to be aware of, seek access to, and use such data. Leontief recently castigated the economics profession in general for its preoccupation with model building without regard to relevant data. Today relevant data very often means current data.

ROLE OF AGRICULTURAL ECONOMISTS REGARDING CONSUMER MARKET RESEARCH AND ANALYSIS

The typical perceived roles of agricultural marketing economists are in the fields of demand and price analysis, price determination, price discovery, and market structure and performance. Reliance in such work has been primarily upon historical secondary data inputs into econometric models. This has sufficed reasonably well for both

agricultural and food policy analysis. Because of data and information limitations, agricultural economists have had to take agricultural product demand largely as a received phenomena, not one that is to be managed, or strategized, except between domestic and export, or fresh versus processed markets, or time differentiated market periods. Searching for market segments among consumers is not the target toward which attention is often directed. Therefore, the rational man, perfect information, normative model generally suffices (Marshall, Hicks). The traditional time series or cross sectional data analysis has an inherent trap. The problem is that by the time historical data reveal market segments, the opportunity curve has usually long since passed.

Marketing research professionals, on the other hand, recognize other consumer behavior models descriptive of market segment group behavior such as the Pavlovian, Freudian, Veblenian, Hobbesian and several others. For example, the Yankelovich national consumer study reveals groups that are either habit (Pavlovian) driven, price (Marshallian) driven, or diet fears (Freudian) driven.

The research upon which this paper is based lies somewhat in between the two foregoing parameters. It is concerned with consumer attitudes, tastes and preferences which lie at the very fulcrum of the utility and demand for products (Branson and Norvell). It concerns consumer utility bundles in the Lancasterian sense. Begun as a search for delineation points in consumer preferences to guide demarcation points in federal beef grade standards, it has also evolved additionally into a market segmentation analysis carrying other possibly significant marketing implications.

WHY A NATIONAL CONSUMER BEEF STUDY

The U.S. beef industry has experienced six massive internal changes within the last two decades. First, efforts to increase production efficiency led to the introduction of Asian cattle breeds, especially Brahmas. Santa Gertrudis, Simmental and a number of

other breeds have appeared that induced changes in beef carcass characteristics. Second a move toward larger carcass-frame animals. Third, the introduction of large feedlots caused geographic shifts in cattle feeding operations. Fourth, kill-and-ship packing plants appeared, and fifth, a transition to boxed beef developed. Electrical stimulation of beef carcasses, a sixth development, was adopted to enhance carcass muscle relaxation and thereby meat tenderness. All activity, however, was not on the beef side.

The poultry industry has significantly reduced the feed conversion ratios for chicken production, which permitted significant downward adjustments in chicken retail prices relative to other meats. As a consequence, per capita chicken consumption gained significantly compared with beef consumption, Table 1. Concern developed over whether there has been a downward shift in the demand for beef (Haidacher, Wohlgenant). Meanwhile, human nutrition debates over cholesterol led the beef industry to be concerned about consumers' interpretations and reactions in terms of purchase behavior (Yankelovich). Also waste fat in carcasses, a major concern, is estimated to cost processors and consumers over one billion dollars per year (West).

The latter factors, in particular, led animal scientists to seek means of producing leaner, less costly beef (Schupp, et. al.) by forage feeding, reduced time on feed concentrates, and feeding young bulls. Therefrom began new evaluations of beef eating quality as related to animal maturity, breeds, marbling scores and quality grades (Adams, Smith and Carpenter; Blumer).

The foregoing, to marketing professionals, has all of the characteristics associated with new product development. In that domain, sensory evaluation of, as well as consumer attitudes and behavior toward, a product is central to current market information which is requisite to formulating new product development and marketing strategies. Several recent beef research projects have been targeted toward such goals

but unfortunately have been unable to provide clear marketing signals.

Examination of the research revealed that the designs may have been overly influenced by production constraints rather than being guided by marketing criteria, thereby causing the research experiments to be too small to be useful guides. Another possible flaw is the usual inadequacy of agricultural economists regarding consumer market research.

OBJECTIVES OF THE NATIONAL CONSUMER BEEF STUDY

The research objectives for the Phase I study were:

1. At what leanness, or degrees of marbling differences, can consumers recognize quality differences, and thereby establish consumer preferences, regarding beef?
2. Which leanness level, if any, appears to be most preferred by consumers, and is there an orderly or a random preference order in terms of overall product palatability?
3. Are geographic regional differences present within the U.S. market?
4. Given the findings of the foregoing objectives, what leanness levels should be subjected to a final retail market test?

These objectives evoked a series of critical design and analysis questions regarding sensory analyses research as noted by Erhardt.

Previous recent research inadequacies largely evolved from inadequate sensory analysis designs, as well as undersized sample designs as encountered, for example, by Schupp and Bidner. Consequently, it was concluded that consumers perceived little or no significant utility preference between U.S. Choice and U.S. Good beef. Key attention in the present project was directed to avoidance of the foregoing design errors. Prior research at the Texas Agricultural Experiment Station by meats scientists and consumer researchers such as Smith and Degner was reviewed to evaluate likely

data statistical variance that would be encountered. Research by others is equally important, but access to raw data files was essential.

PRODUCT RATING SCALE DESIGN

Both a literature review, and a survey among directors of market research departments of several major national food marketing firms, found a concensus favoring a nine point, Likert-type, semantic differential scale for product evaluations. That scale has proven to be a reliable predictor of consumer purchase behavior. Scale centering was at five. Some analysts prefer a centering at three (if the top scale value is nine) for technical reasons which are beyond the scope of this paper. Product satisfaction ratings, which infer utility value differences, were sought on beef tenderness, tenderness desirability, juiciness, juiciness desirability, flavor, and overall product desirability of the beef marbling levels tested.

Product sensory (and preference) evaluations may be conducted at four different levels: by expert laboratory panels, consumer laboratory panels, household panels, or by purchasing consumers. Phase I of the National Consumer Beef Study was designed to encompass the first three levels. Phase II is designed to encompass the fourth, or retail market test level.

SAMPLE SIZE DESIGN

The final Phase I design comprised 10 expert laboratory taste panelists providing 2,700 product ratings; 200 consumer laboratory panelists making 4,000 observations; and 180 households per city that produced about 2,000 ratings per city, or a total of near 8,000. The expert panel was located at Texas A&M University. The consumer laboratory panel excluded students and was a probability sample drawn from the Bryan - College Station metropolitan area (population 110,000). The initial 180 household panel

test was conducted in Houston in 1982, employing a probability cluster sample of 30 clusters and 6 households per cluster. All panel households were qualified as fresh beef consumers at home, and their availability for the ten week test. This household panel was repeated in 1984 in San Francisco (Bay Area), Kansas City and Philadelphia.

The sample size design used the basic standard error formula for a sample mean, with estimates of within and among cluster variances ignored because of lack of cluster level information.

$$\sigma_{\bar{x}} = \frac{c\sigma}{\sqrt{n}}$$

Where: $\sigma_{\bar{x}}$ = standard error of the mean
c = confidence level in standard deviation unit equivalents
 σ = standard deviation in the data
n = sample size

The sample size design was set to detect significant product rating differences at 0.25 rating points in each city, and it exceeded that target. Other recent research had about half the target accuracy.

PANEL DEMOGRAPHICS

Demographics of the sample household compared to the cities involved were favorable, given two caveats (U.S. Census of Population; and Sales and Marketing Management). First, a small amount of sample adjustment was made to achieve representative regional demographics, rather than specific city demographics; and second, households had to qualify as regular fresh beef consumers at home. The final three test cities to represent the West, Midwest and Northeast regions were selected after extensive analyses of all metro areas exceeding or near 1,000,000 population.

Education	Sample	Four Cities
	— percent —	
Grammar school	3	8
High or tech school	43	54
College	52	38
Not reported	2	—
Total	100	100

The sample, as would be expected, was skewed upward in education and income because of the elimination of non-beef eaters.

Viewed in another perspective, the average for the household panel versus the estimated city demographics is noted below.

Mean age difference	2 years
Mean education difference	0.7 years
Mean income difference	5.2 thousands of dollars

PRODUCT SELECTION FOR THE TEST

The test beef represented almost the full range of marbling levels: Low Prime, three levels of Choice, two levels of Good, plus Standard. In Houston, Short-Fed and Bullocks were also added. Beef was selected, in cooperation with USDA graders, from packing plants who are nationwide suppliers, in Colorado, Kansas, and Texas. Only "A" maturity cattle were used. No animal breed control was involved except for exclusion of dominant Brahma-characteristic carcasses. Top loin steaks were prepared for the test and were uniformly trimmed, wrapped, coded, frozen and held at the Texas A&M Animal Science meats processing center until delivery to cold storage facilities at the test sites.

Steaks were provided to the panel in a randomized order to cancel order bias. One steak was delivered per week, and only after the preceding one was consumed. A duplicate sample steak was used at the last week of the test to test the panel's rating reliability.

EXAMPLE OF RANDOMIZED STEAK ORDER

Household No.	Week Number									
	1	2	3	4	5	6	7	8	9	10
	Steak Number									
011	6	8	4	2	3	5	9	1	7	1
012	2	6	8	7	5	1	9	4	3	4
013	4	1	5	9	3	7	8	6	2	8

PRODUCT COOKING AND PREPARATION METHODS

For a product such as beef prepared at home, cooking method and the degree of doneness are important.

All generally prevalent cooking methods were well represented in the combined sample of 8,018 steak ratings.

Cooking Method		Degree of Doneness	
Outside grilling	19%	Rare	19%
Inside grilling	8%	Medium rare	27%
Oven broiling	46%	Medium	32%
Pan fry	26%	Well done	22%
Other	1%	Very well done	10%
Total	100%	Total	100%

Doneness levels pertain to the final three cities and are associated with 6,671 ratings. Standard error estimates at the 95% confidence level of accuracy obviously are small, being $\pm 0.9\%$, 0.6% , and 0.2% for figures of 25%, 10%, and 5% respectively. These are using the basic formula for calculating the standard error of percentages, ignoring clustered sample effects (Ferber; Kinnear and Taylor).

$$\sigma_{\bar{p}} = c \sqrt{\frac{p - (1-p)}{n}}$$

Where: $\sigma_{\bar{p}}$ = standard error of the percentage
 c = confidence level in standard deviation units
 p = percentage having the specified attribute
 n = sample size

TEST OF PANEL RELIABILITY

Ability of the household panels to replicate their ratings was excellent, as judged by covariance tests and "t" tests for significant differences between means, Tables 2 and 3. The repeat steaks were from the same carcass, opposite rib position, of the original steak received, thereby eliminating among carcasses variance.

Comparison of ratings from the laboratory expert panel, the consumer laboratory panel, and the household panel are only possible with respect to the Houston test. All three panels received beef from the same supply to assure comparability. Product ratings by the expert laboratory panel were better predictors of household panel ratings ($R^2 = 0.79$) than was the consumer laboratory panel ($R^2 = 0.52$). In either case, a high correlation would not be expected because cooking methods and doneness were standardized in the laboratory tests, but purposely were not in the household panel. Higher product satisfaction ratings were generally more consistently associated with increases in beef marbling levels by the household panels than by the laboratory panels, Table 4.

NORMALIZATION OF RATINGS

Normalized scores were determined by expressing each panelist's steak ratings in relation to their ratings average over all of the steaks in the test set.

Normalized ratings are determined by the following equation for each product rating.

$$R_{jk} = \frac{R_{jk}}{\frac{\sum_{i=1}^i (R_{ik})/n}{1-n}}$$

$$R_{Xik} = \frac{\sum_{i=1}^i R_{ik}}{n}$$

R_{jk} = kth panelist's rating of product j

$\sum_{i=1}^i R_{ik}$ = sum of kth panelist's rating of all products in the test

n = number of products tested

R_{Xik} = mean of all product ratings by kth panelists

In order to synchronize the individual steak normalized rating, the deviation of the panelist's normalized rating of individual steaks was expressed as a deviation from the mean of ratings for that panelist.

$$RD_{jk} = \sum_{i=1}^i R_{Xik} - R_{jk}$$

RD_{jk} = the deviation of the rating for products j by panelist k

Finally, each individual panelist's normalized ratings are expressed in units of deviation from the total panel's grand mean of ratings over all the product samples.

$$NR_{jk} = \frac{\sum_{i=1}^i R_i}{1-n} + RD_{jk}$$

NR_{jk} = normalized rating for product j by panelist k

$\frac{\sum_{i=1}^i R_i}{1-n}$ = grand mean of all product ratings by the total panel

The objective of normalization is to eliminate variance among panelists' product ratings arising solely from personal differences in the general level used within the scale. Analysis emphasis thereby is directly on differences among steaks.

Though the combined 8,018 observations appear to be unnecessarily large, they are roughly equivalent to one week's consumer purchases in four modern-size supermarkets, a fraction of the weekly operating experience of most food chains.

PRODUCT RATINGS

There appeared to be evidence of ratings differences between Houston and San Francisco as compared to Kansas City and Philadelphia. In the former, nonsignificant differences were found between U.S. High Good and Low Choice grade steaks. This could suggest regional differences and the possible emergence of new taste preferences. However, covariance analysis indicated that the city data may properly be combined because the city effect was not significant with household demographic and beef preparation methods as variants, Tables 5 and 6, (Banks). The standard error estimate of the ratings for the individual grade levels over the four cities was 0.04 rating points, producing statistically significant differences among the sub-grade levels except Medium Choice and Low Choice, Table 7. Tests of the standard error estimates accounting for clustering effects by the following formula found inconsequential differences.

$$\sigma_{\bar{x}_w} = S_{\bar{x}_w} = \sqrt{\frac{G(G-g)}{g(g-1)N^2} \cdot \sum (T_k - \bar{N} \bar{x}_w)^2}$$

Where: G = clusters in population

g = clusters in sample

N = # people in population

\bar{N} = average #/cluster

T_k = sum of ratings/cluster

\bar{x}_w = weighted mean

INTERPRETATION OF PURCHASE INTENTIONS

Research design and analysis methods, to be useful, must be relevant to interpreting actual market behavior. When panelists were asked to interpret their ratings in terms of purchase, it was found that as ratings increased so did purchase intentions, Table 8. Consultations with personnel of national food company marketing research departments brought to a Houston conference to review the research confirmed that product ratings of seven or above generally signify successful products when using nine-point hedonic scales. Since the analyses suggest reliability of the research results, the next question concerns interpretation of the findings.

SEARCH FOR MARKET SEGMENTATION

Generally, higher ratings of USDA Choice beef were clearly indicated. However, because of the multiple attributes of beef, occasionally USDA Good steaks may equal Choice in palatability. This study clearly implies, however, that the probabilities for such an occurrence are quite low. Ratings of USDA Good grade beef were generally lower, with better acceptance indicated in the West (San Francisco) and Southwest

(Houston). This concurs with long prevailing general industry market perceptions. Therefore, an evaluation of the consumer market for leaner beef (less than Choice grade) required further analysis. A decision was made to test a market segmentation hypothesis. It was determined upon further analysis that about twenty-five percent of the panelists rated the overall eating quality of U.S. Good grade beef as seven or better. Despite this rating, this segment of the panelists gave still higher ratings, on the average, to U.S. Choice and above grades. Only one panelist among over 800 in the three city panel rated both Choice and Prime steaks lower than a U.S. Good steak. That incidence suggests no more than a chance data abnormality. Nonetheless, suggested is a possibly viable market segment that would be willing to make some product palatability sacrifice in a trade-off to gain product leanness. The relevant marketing question turns on the possibility of an improved product attribute bundle in the Lancasterian product preference sense (Lancaster). Would or does such a product fill consumer demand space that is empty, or only partially filled, as suggested by Padberg and Westgren?

Market segmentation, though not new, is becoming increasingly used in consumer and industrial markets as noted by Doyle and Sanders. Despite that, it seldom has been fully applied to the retail fresh beef market, except for ground beef. Marketing of calf beef is not considered here as a multigrade marketing strategy. Almost without exception, retail food supermarkets offer U.S. Choice or U.S. Good or so-called "No-Roll." The latter is ungraded beef which usually is below U. S. Choice grade, or if Choice it may be from Yield Grade 4's and 5's, which means a high amount of carcass waste fat. The obvious marketing problem with "No-Roll" beef is that it increases product variability at a time when the dominant trend in the consumer market is toward product reliability. Consumers do not generally respond well to a U.S. Good

grade label. USDA grades were really intended for wholesale, not retail, application according to A.M.S., U.S.D.A. Previous research suggests that consumers may not have the affinity expected of them for USDA beef grades (Branson).

Whether or not a nationwide industry strategy of simultaneously retail marketing two grades of beef in most supermarkets is a viable one must be proven by subjecting the concept to a retail market test. Phase II of the National Consumer Beef Study is designed toward that purpose. A pilot test, already conducted, suggests that the concept may have potential (Branson, Cross, Savell and Edwards). The perceived strategy is to market simultaneously U.S. Choice beef and a private brand label of specification controlled leaner beef that would be from U.S. Good grade Yield Grade 2 carcasses. If further research supports such a strategy, a further question concerns the implications it may hold for the future beef marketing structure.

MARKET STRUCTURE AND PERFORMANCE IMPLICATIONS

One can only hypothesize as to what market structure and performance implications could evolve from the National Consumer Beef Study findings. Several scenarios may be postulated.

Scenario I is that the total marketing system would rapidly move to a dual-grade retail marketing strategy assuming Phase II of the research supports the market segmentation strategy. In that event, it is likely that no structural effects would emerge. If that does not materialize, scenario II is the opportunity for one or more major packers to aggressively pursue a marketing strategy of launching their own national brand of lean beef. It might emulate, in part, the Holly Farms strategy for poultry. It has been decades since packer brands were dominant in supporting beef marketing.

Internal economies of new, independent, kill-and-ship packing plants led in part

to the present national brand demise. If that is replaced by strong packer brand marketing, interest would again arise regarding the total industry effects on market entry, pricing, and availability of markets to producers and feedlots outside the system, especially if a degree of vertical integration followed. Possible marketing efficiency losses, if any, would have to be weighed against whether consumer beef demand gains were evoked from filling the conceptual empty consumer demand space. Active brand advertising could expedite the process. This second scenario could also expedite the recent move toward boneless, fully-trimmed beef via a branded, tray-ready product from packing plants. Product innovation potentials from new technology might be expedited by such a reformation of the industry. In that event, competition may be enhanced in the fuller sense of the word as interpreted within the IBM case rulings. Economists have not been very effective in evaluating such competition. Renewed efforts are sorely needed in this area.

Scenario III would be vigorous pursuit of the concept by national and regional food chains. By means of specification buying, the impact could be dispersed over the present array of packing firms and all share in its relative costs and benefits. It could, however, provide an enhanced impetus for food chain backward integration into packing plants and feedlots. The historical record of cyclical profitability of packing plants and feedlots would seem to mitigate against such integration. However, a recent survey by the Market Research Center at Texas A&M suggests that boneless, fully trimmed beef is being used by a few food chains as a means of escaping intensive price competition at the retail level. That may enhance the incentive to adopt an integration program via contract suppliers, if not by ownership.

Regional locational effects would probably not be appreciably affected since the economies of location would remain active. However, Clary and Farris found in the

case of boxed beef that the competitive position of the larger firms was improved at the expense of local market purveyors.

The more likely prospect from general adoption of the dual-grade marketing program would be to add impetus to the establishment of premiums and discounts regarding carcass and yield grades. Premiums would be supported for Yield grade 1, 2 and 3 cattle while discounts may become more apparent for carcasses below U.S. Good, Yield Grade 2 and 3 classifications. Changes are already in prospect and market price effects are being seen as some food chain divisions presently are increasing their demand for Yield grade 2, U.S. Good grade beef supplies.

Two possibilities could emerge at the cattle raiser level. A clear-cut, two-grades strategy at retail could expand demand for lean beef as herein defined. Good grade prices, therefore, might rise until the production system adjusts to the market demand shift. Thereby production of a high quality lean beef would be stimulated if the marketing system properly transmits signals.

A second phenomenon is a prospect. In theory, total product class demand in a properly segmented market (assuming the segments exist) should exceed that in a non-segmented market because the postulated empty consumer demand spaces would be filled. Therefore, total beef demand would expand. The pilot store test suggests that this may be the case. These possibilities suggest why the future research under Phase II of the National Consumer Beef Study can be an exceptionally challenging one.

CONCLUSIONS

The purpose of the National Consumer Beef Study- Phase I was to determine consumer beef preferences among leanness levels in beef, since they can affect consumer utility maps and product market demand. Knowledge of these is necessary to guide U.S. future beef production, grading and marketing practices. Reevaluation was

necessary to properly assess effects of recent changes in beef production and processing, and in national consumer dietary concerns with fat and cholesterol. Lead time from market research is important because time is required to appreciably modify the product characteristics of the beef supply output. Results of the research suggest the possibility of a segmented demand for beef: separate consumer demand spaces for U.S. Choice grade beef, and for a branded "lean" beef. Final proof depends upon completion of Phase II -- Retail Market Test -- of the research. Identification of consumer market segmentation requires that economists obtain current market data based on meaningful, relevant consumer behavior models. Traditional analyses of secondary market data have limited potential for success.

Market structure implications of simultaneous marketing of two kinds of beef in major supermarket food stores would vary with the course of the marketing strategy adoption process. If broad early adoption occurs, little, if any, structure impact is likely. If adoption is aggressively taken by selected packers or food chains, a further motivation for market integration might occur. Marketing and pricing efficiency is likely to increase in relation to consumer preferences. Desirable quality lean beef with high carcass yields may be more equally priced with U.S. Choice beef. That could encourage beef production that is better aligned to total market needs. Theoretically, total beef demand vis a vis other meats and foods would be positively affected and would serve the long range interest of the beef industry.

Questions are posed as to the sufficiency of agricultural economists' knowledge of consumer behavior. Agricultural marketing economists in this kind of marketing problem need a full understanding of consumer demand formation, as well as econometric methods and principles.

Table 1. U.S. Per Capita Civilian Consumption of Meats, 1955-1983.

Year	Beef	Pork	Chicken
		- - - pounds - - -	
1955	82	67	21
1960	85	65	28
1965	100	59	33
1970	114	73	40
1975	119	55	40
1976	129	60	43
1977	126	62	45
1978	120	61	48
1979	108	70	52
1980	103	74	50
1981	104	70	52
1982 ^{1/}	104	63	53
1983 ^{1/}	107	66	54

^{1/} Preliminary

Source: Agricultural Statistics, selected years, and Statistical Abstract of the United States, 1985, U.S.D.A.

Table 2. Covariance Analysis of Ratings of Test and Re-test Low Choice Beef Steaks, Philadelphia Household Panel, 1984.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F
Grade ^{1/}	0.86	1	.86	0.62
Cooking Method	0.46	3	.15	0.11
Degree of Doneness	5.90	5	1.18	0.84
Grade x Cooking Method	2.73	3	.91	0.65
Grade x Degree of Doneness	9.00	5	1.80	1.29

^{1/} Test versus re-test comparison.

Table 3. Mean Ratings of Repeat Panelists Who Ate All 8 Steaks, Three Cities Combined, National Consumer Beef Study, 1984.

Steak Designation	N	Mean Rating	t
Low Choice -- Test	728	7.15	.09 n.s.
Low Choice -- Re-test	728	7.24	

Table 4. Average Ratings of Beef Loin Steak Marbling Levels by Expert, Consumer Laboratory and Household Panels, 1982 — Houston.

Marbling Level	USDA Quality Grade	Expert Panel	Consumer Laboratory Panel	Household Panel
			--- rating ¹ ---	
Slightly abundant	Low prime	6.96	6.72	7.17 ^a
Moderate	High Choice	6.54	6.58	7.13 ^a
Modest	Medium Choice	6.28	6.15	6.87 ^b
Small	Low Choice	5.89	6.02	6.83 ^b
Upper slight	High good	5.53	5.77	6.81 ^b
Traces	High Standard	5.64	5.84	6.78 ^b
Slight	Bullock ²	5.47	5.65	6.54 ^c
Slight	Short-fed ²	5.32	5.47	6.51 ^c
Total Number of Observations		2,700	4,000	2,800

Source: Expert and laboratory panels at Texas A&M University; household panel in Houston, Texas.

1 Based on nine-point, five centered, hedonic scale with 9 extremely desirable and 1 extremely undesirable.

2 Cattle type.

Table 5. Stepwise Regression of Consumer Beef Panel Ratings of Top Sirloin Steaks, 1984.

Variable	F Value	Probability
City	3.41	0.0650
Grade of Beef	100.80	0.0001**
Income	0.01	0.9409
Age	0.00	0.9835
Education	0.21	0.6431
Cooking Method	0.02	0.8839
Degree of Doneness	8.20	0.0042**

** Significant at confidence level of 99%

Table 6. Covariance Analysis of Beef Ratings, Three Cities Combined ^{1/}.

Source	Degrees of Freedom	F Value	Probability
City	2	1.01	0.363
Grade of Beef	6	1.92	0.073 *
Panelists			
Income	9	2.28	0.015 **
Age	6	6.46	0.000 ***
Education	3	2.62	0.048 **
Steak Preparation			
Cooking Method	4	1.40	0.232
Degree of Doneness	3	6.28	0.0001 ***
Interactions of Ratings			
City and Grade	12	1.31	0.203
Grade and Cooking Method	24	1.07	0.374
Grade and Degree of Doneness	18	0.61	0.892
Total	4614	2.67	0.0001

* Significant at confidence level of 90%.

** Significant at confidence level of 95%.

*** Significant at confidence level of 99%.

Table 7. Mean overall desirability rating of loin steaks by marbling level, normalized data — four cities combined.

Marbling Level	USDA Quality Grade	Mean	Standard Error
Slightly abundant	Low Prime	7.24 ^a ²	.04
Moderate	High Choice	7.15 ^b	.04
Modest	Medium Choice	7.00 ^c	.04
Small	Low Choice	7.05 ^c	.04
Upper Slight	High good	6.90 ^d	.04
Lower Slight	Low Good	6.82 ^e	.04
Traces	High Standard	6.76 ^e	.04
Total Number of Observations		8,018	

1 Based on nine-point, five centered, hedonic scale with 9.0 as highest rating.

2 Means followed by same letter superscript are not significantly different at the 95 percent confidence level.

Table 8. Purchase Intentions of Consumers as Related to Beef Loin Steak Ratings — Four Cities Combined.

Steak Rating		Would Buy	Probably Buy	Buy Only At Reduced Price	Would Not Buy At Any Price
Numeric	Semantic				
- - - percent of food shoppers ¹ - - -					
9	Extremely Desirable	85.0	10.2	3.9	.2
8	Very Desirable	65.8	27.5	3.3	.7
7	Moderately Desirable	19.6	44.7	10.6	3.4
6	Slightly Desirable	3.6	20.1	25.8	13.8
5	Neither Desirable Nor Undesirable	.7	5.9	35.0	29.3
4	Slightly Undesirable	2.1	2.9	35.0	52.4
3	Moderately Undesirable	2.1	2.2	10.6	77.8
2	Very Undesirable	2.3	2.1	4.2	88.7
1	Extremely Undesirable	6.3	0.0	6.4	86.9

¹ Row percentages which do not add to 100 are due to those food shoppers who were "undecided" being omitted.

FOOTNOTES

¹Behavior Scan data from Information Resources, Inc. of Chicago, Illinois

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