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Consumer Acceptance of Round Steaks Tenderized by Cubing and Papain

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SUMMARY

Interest in the impact of enzymatic tenderization on consumers' evaluation of beef flavor, tenderness, and juiciness led to this study. Tenderness, as well as other sensory factors such as juiciness and flavor, is a major influence on the acceptance of beef. This study was designed to relate these sensory factors to other variables, such as carcass, grade, and treatment of beef.

The two survey groups were composed of 30 families each in two separate areas of Columbia, Mo. One panel tested grill-type round steaks, and the other panel was furnished minute steaks. The reader is cautioned to keep in mind the small size of the samples in evaluating the results and conclusions.

Ten Choice and 10 Utility carcasses were used in this experiment. The grill steaks were processed from the top rounds and the minute steaks were processed from the bottom rounds. Alternate steaks from rounds of each grade served as control treatments. The other steaks were dipped in a solution containing an enzymatic tenderizer.

The panel that sampled the grill-type round steaks indicated that Utility beef was more acceptable when enzymatically tenderized. Grill steaks from Utility carcasses consistently received superior acceptance ratings when tenderized. In the Choice grill steak comparisons, tenderizing gave slightly higher acceptability ratings. Flavor, tenderness, and juiciness were all improved by the use of a tenderizer.

The enzymatic tenderizer had a definite unfavorable effect on the minute steaks used along with a mechanical process for tenderization. In general, the minute steak testing panel considered the tenderized treatments of both grades considerably less acceptable, but the sensory characteristics of these steaks were not held to be totally undesirable.

The Utility tenderized minute steaks had a smaller percentage shift in ratings to the lower categories for juiciness and flavor than was true for the Choice grade. These tendencies would suggest that, especially for the leaner grades, tenderness may be improved without sacrificing other desirable qualities.

There was no evidence to indicate that the degree of defrosting influenced the impact of the tenderizer on either type of steak.

The panel's being informed of the possible use of a tenderizer did not alter the ratings of the steaks.

The less desirable qualities of the meat received several comments during the first stage of the study, but only a few households attributed the change in characteristics to a tenderizer.

Consumer Acceptance of Round Steaks Tenderized by Cubing and Papain

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INTRODUCTION

The determination of consumer preferences has been an area of special interest to researchers in recent years. A series of such studies has been conducted at the Missouri Experiment Station. The Departments of Agricultural Economics, Animal Husbandry, and Home Economics have completed several investigations of consumer acceptance of livestock products.^{1,2,3,4,5,6*} These investigations have been concerned not only with visual preferences but also with the sensory factors relevant to the consumer's acceptance of the product.

For eating satisfaction the consumer demands tenderness, tastiness and juiciness, in that order.^{1,7} If the meat is tough, it is generally objectionable, irrespective of all other qualities.⁸

For a number of years mechanical methods have been employed to make meat tender. More recently commercial tenderizer preparations of enzymes have been put on the market. The basic ingredient of these tenderizers is the proteolytic enzyme, papain. Reports of laboratory tests on the effectiveness of papain are found in the literature as early as 1942.⁹ There have since been laboratory experiments on the effectiveness of various commercial tenderizers.^{10,11}

Little research has been done at the consumer level to determine the satisfaction derived from the use of these preparations.¹² Hay, Harrison, and Vail did find a strong preference for the tenderized retail cuts used in their study of commercial tenderizers.¹³ This preliminary research indicated improved palatability with the use of a tenderizer. Tenderness was the deciding factor for the preference of the treated steaks.

Purpose

This bulletin is a report on a study of the impact of enzymatic tenderization on the consumer acceptance of beef. The survey was conducted in Columbia, Mo., with the cooperation of 60 families. Each family received both control and tenderized steaks. One type of steak was treated with only the enzy-

*Numbers refer to list of references in the back.

matic tenderizer while the other was also tenderized by mechanical means. The primary purpose was to compare the cooperators' acceptance of control treatments and the tenderized treatments of beef.

Objectives

The specific objectives of the study were:

1. To determine the differential impact of an enzymatic tenderizer on consumer evaluation of the tenderness, flavor, juiciness, and general acceptability of beef of two different grades.
2. To determine the interaction of mechanical and enzymatic tenderization and the resultant effect on consumer satisfaction.
3. To determine the difference in ratings and comments when the household was informed of the possible use of a tenderizer.
4. To learn if the household could detect differences in flavor, tenderness and other conditions when not told the product was tenderized.

EXPERIMENTAL PROCEDURE

Rounds were used for this study since steaks from this cut of beef are some of the most troublesome for their lack of tenderness.⁶ The top rounds were processed into grill steaks. Minute steaks were made from the bottom rounds. Separate panels were recruited to test these two meat groups.

Panels were concentrated in widely separate areas of Columbia in an effort to lessen the degree of communication between panels.

The panel to test the minute steaks was recruited in University Court, an area used for housing University of Missouri faculty members. Thirty householders were obtained as cooperators.

The panel for testing the grill steaks was recruited in or near the Quarry Heights residential area. From the arbitrary starting point, every other householder was interviewed until 30 cooperators had been obtained.

Eligibility requirements for households were:

1. That the householder be familiar with the product.
2. That the household have two adult members.
3. That the householder agree to use a dry heat method of cookery for the meats in this study.
4. That neither adult member of the household shall be a technical expert concerning meat.
5. That the householder agree to cooperate in the study.

In recruiting each of the panels, the interviewer called back at a later date if the householder was absent at the time of the first call. The call-backs were not limited to one per living unit nor were they made at the same time of the day. This procedure was followed to allow house-holders an opportunity to cooperate regardless of their at-home schedule.

The experiment was designed to use two grades of beef—U. S. Choice and U. S. Utility. Each household received both control and tenderized steaks of each grade. The experiment consisted of two stages with a total of four deliveries (one of each treatment of each grade) per stage. The two stages were replicates except for the order of the deliveries. All steaks of one grade and treatment were delivered to the entire panel within a given week. The order of delivery for the first stage was randomly determined to be:

- First week—Choice control
- Second week—Utility control
- Third week—Choice tenderized
- Fourth week—Utility tenderized

In the course of the experiment each household received two control and two tenderized treatments of each grade. These four treatments of each grade for one household were prepared from the same carcass. One carcass supplied enough product for three families on each panel. With each panel consisting of 30 families, a total of 10 carcasses of each grade was required.

The meats laboratory of the university procured 15 rounds each of U. S. Choice and U. S. Utility grades. The rounds were aged 10 days at 38° F. The top and bottom rounds were then separated and frozen at -20° F. While frozen, the steaks were cut on a band saw to obtain uniformity of thickness. Each round was measured for its shear value. Shear values were obtained by the Warner-Bratzler method, using a 1-inch core measure. Two cores, sheared three times each, were taken from each round. The 10 Choice carcasses having the lowest shear values and the 10 Utility carcasses with the highest shear values were used. The shear values for the 10 Choice carcasses ranged from 11.08 to 15.5 pounds with a mean shear value of 13.97. The range for the 10 Utility carcasses was from 16.33 to 26.25 pounds, and the mean shear value was 19.32.

The grill steaks were ½ inch thick. The odd numbered steaks served as controls; the even numbered steaks were dipped in a solution containing a proteolytic enzyme tenderizer, papain.**

The minute steaks were ⅜ inch thick. They were tenderized mechanically in a commercial cubing machine; odd numbered steaks served as the control and even numbered steaks were dipped in the tenderizer solution which had been diluted one-half with water.

The steaks were big enough to be cut in two to serve both adult members of the household. The frozen steaks were delivered to both panels once a week for eight weeks. At each weekly delivery, the interviewer furnished the householder with an evaluation schedule on which the two adults listed their separate opinions of the product (Figure 1). A nine-point hedonic scale¹⁴ was used to indicate the acceptability of the steak while four-point scales were used to measure each of the three sensory characteristics.

**The tenderizer used in this particular experiment was FM-102 Meat Seasoning and Tenderizer Solution, obtained from Freezer Laboratories, Inc., 3755 South Racine, Chicago, Illinois. The ingredients were water, salt, monosodium glutamate, papain, sugar and flavoring.

COLUMBIA BEEF PANEL
University of Missouri
Winter, 1958

DIRECTIONS: The husband should eat the steak marked with a ring. The wife should eat the no-ring steak. Be sure to eat the entire steak before answering the following questions.

1. Each of you please check your opinion of your minute (round) steak.

Mr. (ring)	Mrs. (no-ring)	
_____	_____	Like Extremely
_____	_____	Like Very Much
_____	_____	Like Moderately
_____	_____	Like Slightly
_____	_____	Neither Like nor Dislike
_____	_____	Dislike Slightly
_____	_____	Dislike Moderately
_____	_____	Dislike Very Much
_____	_____	Dislike Extremely

2. Compared to the average minute (round) steak at the store, how were these steaks?

Mr.	Mrs.	Tenderness	Mr.	Mrs.	Juiciness
_____	_____	More Tender than Average	_____	_____	More Juicy than Average
_____	_____	As Tender as Average	_____	_____	As Juicy as Average
_____	_____	Less Tender than Average	_____	_____	Less Juicy than Average
_____	_____	Tough!	_____	_____	Dry!

Mr.	Mrs.	Flavor
_____	_____	Better Flavor than Average
_____	_____	As Good Flavor as Average
_____	_____	Poorer Flavor than Average
_____	_____	Terrible!

3. Defrost before cooking?

Completely Partially Not at all

4. How cooked?

Pan Fry Grill
 Broil Other (specify) _____

5. Degree of Doneness:

Well (no pink meat)
 Rare (some pink meat)

6. Comments: (Both favorable and unfavorable comments are useful to us and are greatly appreciated.)

7. Name _____.

Figure 1.--Evaluation schedule furnished with each package of steaks.

Cooperators were asked to eat the entire steak and immediately record their opinions. The completed schedule was picked up the following week. Any relevant comments made to the interviewer, which had not been listed on the schedule, were added.

No mention was made of the use of a tenderizer until the beginning of the fifth week. At that time every householder was told that a tenderizer might be applied to any or all meats in the remaining deliveries. They were asked to note on the schedule for each delivery in the second stage whether or not they thought a tenderizer had been used.

CONSUMER PANEL RESULTS

The analysis for each panel is presented separately and then comparisons are made.

Panel Evaluations of Grill Steaks

Acceptability

The acceptability ratings did not vary significantly between the two grades or the two treatments of the grill steaks. However, nine of the 10 Utility carcasses received superior mean ratings (smaller scores) for the tenderized steaks (Table 1). The tenderized steaks of the remaining Utility carcass were as acceptable as the control steaks.

TABLE 1--GRILL STEAK PANEL MEAN ACCEPTABILITY RATINGS OF CARCASSES BY GRADE AND TREATMENT

Carcass Number	Choice		Carcass Number	Utility	
	Control	Tenderized		Control	Tenderized
C- 1	2.92	2.58	U- 1	2.58	2.00
C- 2	3.42	4.50	U- 2	4.83	4.50
C- 5	2.92	3.33	U- 3	3.92	3.67
C- 6	3.58	2.75	U- 4	4.17	3.17
C- 8	3.17	2.08	U- 5	4.08	3.17
C-10	3.33	2.83	U- 8	3.33	2.25
C-11	3.83	3.08	U- 9	4.33	3.30
C-12	3.00	4.00	U-10	4.08	3.83
C-13	2.42	2.83	U-12	2.58	2.58
C-14	3.67	3.17	U-14	5.17	3.75
Average Mean	3.23	3.11	Average Mean	3.91	3.22

Six of the 10 Choice carcasses did receive superior mean ratings for acceptability of the tenderized treatments. The other four Choice carcasses received poorer ratings for the tenderized steaks.

The average mean ratings for the two grades indicated some difference between treatments. That the tenderized treatments were a little more acceptable was reflected in the 3.11 mean rating for that treatment, whereas the average mean for the Choice control treatments was 3.23.

The average mean ratings for the two treatments of the Utility carcasses differed even more but still not to a degree that was statistically significant. The Utility control treatments had an average mean rating of 3.91 whereas the tenderized treatments of these carcasses averaged 3.22 for acceptance. An analysis of the variance between grades and treatments is summarized in Table 2. Neither the grade nor the treatment had a significant effect on the acceptability reaction of the consumer.

TABLE 2--ANALYSIS OF THE SOURCE OF VARIATION IN ACCEPTABILITY BY THE GRILL STEAK PANEL

Source of Variation	Degrees of Freedom	Mean Square	Observed F	Probability
Between Grades	1	1.52	2.95	.10
Between Treatments	1	1.60	3.11	.10
Between Grades and Treatments	1	.53	1.03	--*
Within Carcass	36	.515		

Grade Means		Treatment Means	
Choice	Utility	Control	Tenderized
3.125	3.515	3.12	3.52

*Probability exceeds .25.

The 10 Utility carcasses were grouped according to a high, medium, or low shear value and a comparison was made of the difference in consumer satisfaction between treatments. The acceptance ratings of these three groups were not significantly different.

In a few instances a single household seemed to be responsible for the inferior rating of a carcass. For Carcasses C-12 and C-13, single households rated the tenderized steaks considerably poorer than did the other two households testing steaks from the same carcass (Table 3). The household ratings of the control steaks for these carcasses fell within a rather narrow range. Had there been a comparable range for the tenderized treatments, the mean rating for that treatment of each carcass would have been superior to the mean rating for the control steaks.

TABLE 3--MEAN ACCEPTABILITY RATINGS FOR INDIVIDUAL HOUSEHOLDS FOR TWO CHOICE CARCASSES

Carcass	Household	Control Treatment	Tenderized Treatment
C-12	(52	3.00	2.00
	(53	2.75	7.00
	(54	3.25	3.00
C-13	(55	3.00	1.75
	(56	2.25	5.25
	(57	2.00	1.50

Individual Sensory Characteristics

Tenderness, juiciness, and flavor of each steak were rated separately on a four-point scale by the two panel members in each household. The ratings of the husbands and the wives were summed for making the percentage calculations. Figure 2 illustrates the panel's ratings of these characteristics for each grade and treatment of the steaks.

Tenderness.—The tenderizer enhanced the tenderness of both grades (Figure 2). Steaks of greater initial tenderness (Choice) were improved slightly more by the tenderizer than were the Utility grade steaks. In the few cases where the tenderized steaks were rated as tough, the consumer complained of excessive connective tissue.

Juiciness.—The grill panel found the tenderized steaks of both Choice and Utility grades to be more juicy than the control steaks (Figure 2).

Flavor.—More tenderized steaks than control steaks were rated as having better flavor than average, but there were more of the tenderized steaks judged as having a "terrible" flavor (Figure 2). Two households (four adults) assigned 14 of the 22 "terrible flavor" ratings. The ratings assigned by the other 28 households on the panel indicated a preference for the flavor of the tenderized steaks. A few consumers apparently differ from other consumers concerning the flavor of tenderized steaks, or else the flavor of the tenderized steaks varied considerably.

Degree of Defrost

Since the tenderizer has slow activity at room temperature,⁹ it was felt that the degree to which the meat was defrosted might have some effect on ratings given various characteristics. The panel's ratings for tenderness and for juiciness were studied in relation to the degree of defrosting.

About 80 percent of the grill steaks were defrosted completely before cooking. Tenderness and juiciness ratings were not related to the degree of defrosting.

Comments

The grill steak panel was rather sparing in its comments on the meat. Comments were quite general in nature and usually implied a favorable or unfavorable acceptance of the product (Table 4). Unfavorable comments were more frequent during the first stage of the study. The panel felt that the dry heat method of cookery they were asked to follow made it difficult to judge the meats. Most housewives previously had employed some moist heat method of cooking round steaks.

The grill steak testing panel was fairly accurate in determining when a tenderizer had been used. Moreover, two households detected the use of a tenderizer in the first stage before it had been mentioned by the interviewer.

Panel Evaluations of Minute Steaks

It should be mentioned at the outset that for the tenderized treatments of the minute steaks there was limited laboratory testing of the enzyme. It was im-

GRILL PANEL

Control
Tenderized

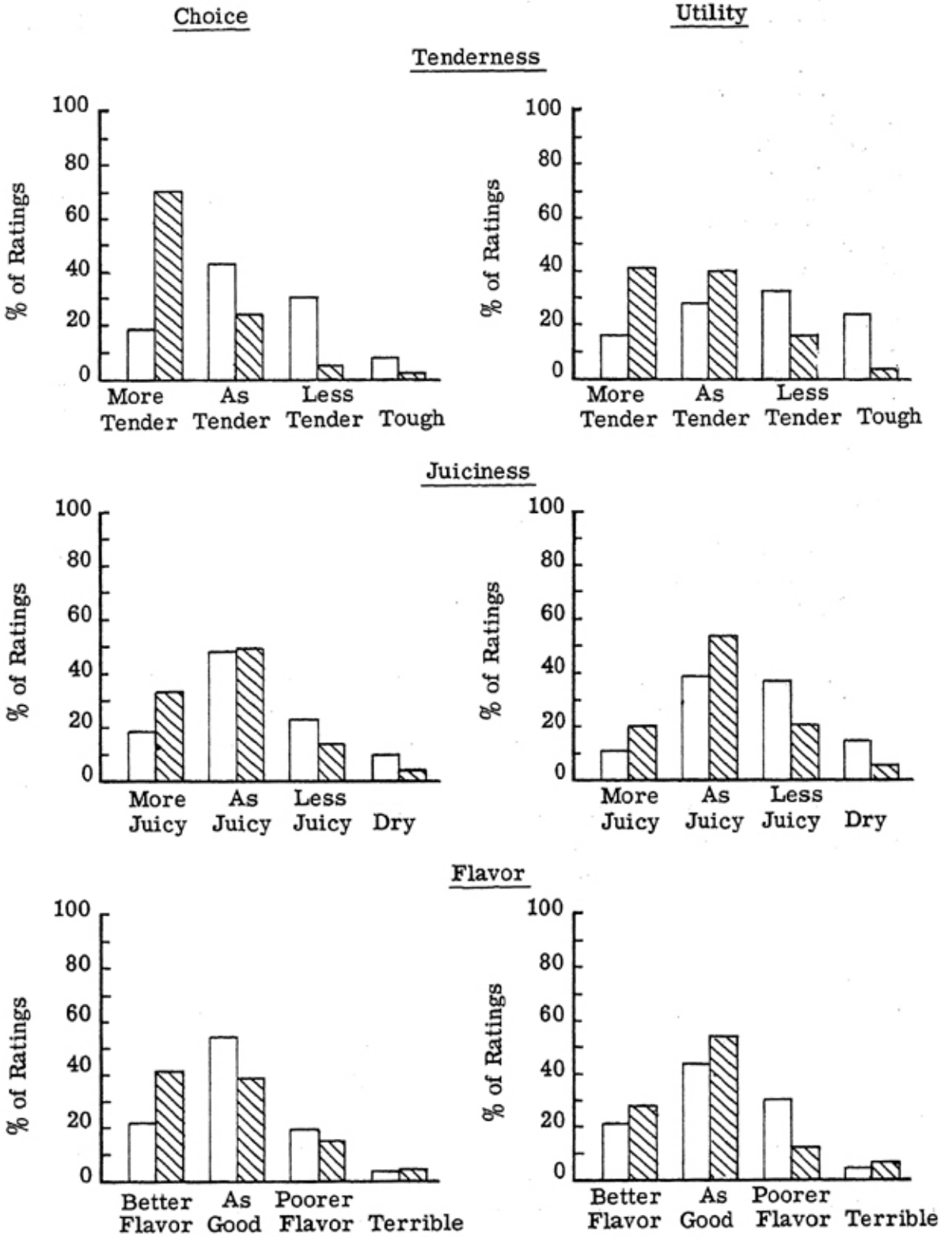


Figure 2.—Sensory ratings of both grades of grill steaks.

TABLE 4--MISCELLANEOUS COMMENTS BY GRILL STEAK PANEL
BY STAGE AND TREATMENT

Comments	First Stage		Second Stage	
	Control	Tenderized	Control	Tenderized
Method of cookery made comparison difficult	10			
Tough connective tissue	3	3		
Well Marbled	3			
Entirely Satisfactory	5	13		7
Unsatisfactory	1	1	2	1
Tough in spots	3	1	3	1
Easy to cut, hard to chew	2			1
Lost juice	5			1
Fell apart when cooked		2		
Texture:				
Mealy		4		
Mushy		2		1
Soft (too tender)		3		1
Stringy		4		2
Flavor:				
Not tempting	5	1		4
Liver	1			1
Good	8	3	3	6
Tenderizer:				
Believe one used		4	5	33
Believe one not used			31	7
Uncertain			24	20

mediately recognized that the strength of the solution as used for the grill steaks was excessive for the minute steaks. The solution, therefore, was diluted one-half with water. However, the activity of the enzymatic tenderizer still greatly exceeded the optimum level when used in connection with the mechanical method of tenderization. While this excessive tenderizer activity diminished the consumer satisfaction with the minute steaks, an excellent example of consumer reaction to a marginal product was provided.

Acceptability

Acceptability ratings for tenderized treatments of minute steaks were significantly poorer than the ratings for control treatments (Table 5). Mean acceptability rating for the tenderized treatments of Choice carcasses was 5.64; rating for the Utility carcasses was 5.34 (Table 6). Range for the mean ratings of tenderized treatments of Choice carcasses was 3.75 to 8.00. These ratings for Utility carcasses ranged from 3.20 to 6.90. In no case did the tenderized minute steaks of a Choice carcass receive an acceptability rating superior to that of the control steaks. Only two Utility rounds—two with very poor control ratings—were improved in acceptability by this method of tenderization.

The difference (2.5) between the average mean of the Choice control and the Choice tenderized was greater than the difference (1.2) between the average

TABLE 5--ANALYSIS OF THE SOURCE OF VARIATION IN ACCEPTABILITY BY THE MINUTE STEAK PANEL

Source of Variation	Degrees of Freedom	Mean Square	Observed F	Probability
Between Grades	1	1.26	1.26	--*
Between Treatments	1	34.78	34.78	.01
Between Grades and Treatments	1	4.56	4.56	.05
Within Carcass	36	1.00		
<u>Grade Means</u>		<u>Treatment Means</u>		
Choice	Utility	Control	Tenderized	
4.36	4.72	3.60	5.47	

*Probability exceeds .25.

TABLE 6--MINUTE STEAK PANEL MEAN ACCEPTABILITY RATINGS OF CARCASSES BY GRADE AND TREATMENT

Carcass Number	Choice		Utility		
	Control	Tenderized	Carcass Number	Control	Tenderized
C- 1	3.42	4.83	U- 1	3.58	4.67
C- 2	2.92	7.00	U- 2	3.92	5.33
C- 5	2.75	6.83	U- 3	3.83	5.50
C- 6	3.10	6.30	U- 4	3.90	6.90
C- 8	2.83	5.08	U- 5	3.92	5.42
C-10	2.83	3.75	U- 8	6.17	3.20
C-11	2.50	3.83	U- 9	4.25	5.50
C-12	2.83	5.42	U-10	3.08	5.50
C-13	3.67	8.00	U-12	3.92	6.58
C-14	4.33	5.50	U-14	5.00	4.75
Average Mean	3.12	5.64	Average Mean	4.16	5.34

means of the Utility control and the Utility tenderized, indicating greater deterioration in acceptability of the Choice by tenderization.

There was no significant difference between the acceptability ratings assigned the two grades of beef tested when the ratings for the two treatments were combined. However, for the control treatments only, the Choice steaks were significantly more acceptable than the Utility steaks. The mean rating for all 10 Choice control carcasses was 3.12, and the mean ratings for individual carcasses ranged from 2.50 to 4.33. The mean rating of control treatments of the 10 Utility carcasses was 4.16, and the mean acceptability ratings for individual carcasses ranged from 3.08 to 6.17. However, seven of the carcasses fell within the much narrower range of 3.50 to 4.25.

Individual Sensory Characteristics

As in the grill panel, the husband and wife separately judged the various characteristics of the minute steaks. The ratings for the characteristics were tabulated for each grade and for each treatment within the grade.

Tenderness—The impact of the tenderizer on minute steaks was considerable (Figure 3). None of the tenderized steaks of either grade was judged to be tough. Utility tenderized steaks that rated less tender than average were further criticized for excessive connective tissue. It would seem in this experiment that the tenderizer had little or no effect on such tissue. This agrees with a previous study which found papain less effective on collagen.¹⁵

Juiciness.—It is true that a greater percentage of the tenderized steaks than of the control steaks were considered "more juicy than average" (Figure 3). But it is also true that an even greater percentage rated the tenderized steaks "less juicy than average" or "dry" than in the case of control treatments. In several instances the panelists felt the natural juices had been destroyed.

Flavor.—The panel's reaction to the flavor of the tenderized steaks was unfavorable (Figure 3). More than one-half the tenderized steaks of each grade were classed as having a "poorer than average" or "terrible" flavor. This criticism is in sharp contrast to the 88 percent of the Choice control steaks and the 73 percent of the Utility control steaks that were rated as having a flavor as good as or better than the average.

Degree of Defrost

Approximately two-thirds of the minute steaks were defrosted completely before cooking. The degree of defrosting apparently did not affect the impact of the tenderizer on the characteristics of tenderness and juiciness.

Comments

In general, comments were a further indication of the specific qualities which panel members considered most notable. Either the presence of tough connective tissue or the steaks' being tough in spots was frequently mentioned for the control treatments (Table 7). While there were a few reports of poor flavor among the control steaks, the number of such comments increased considerably when the meat was tenderized.

The texture of the meat elicited no comments until a tenderizer was applied. The first deliveries of tenderized meats evoked such criticisms as: "a powdery consistency," "mushy," "pasty," "more like wet cardboard than meat," and "a mealy texture."

A good many of the tenderized steaks fell apart when cooked; several panel members could not eat them.

Although the panel felt the flavor of the steaks was less pleasing, they found it difficult to describe the flavor of the tenderized meat. About all they could say was that it seemed to lack flavor. That the altered texture masked the flavor was

MINUTE PANEL

Control
Tenderized

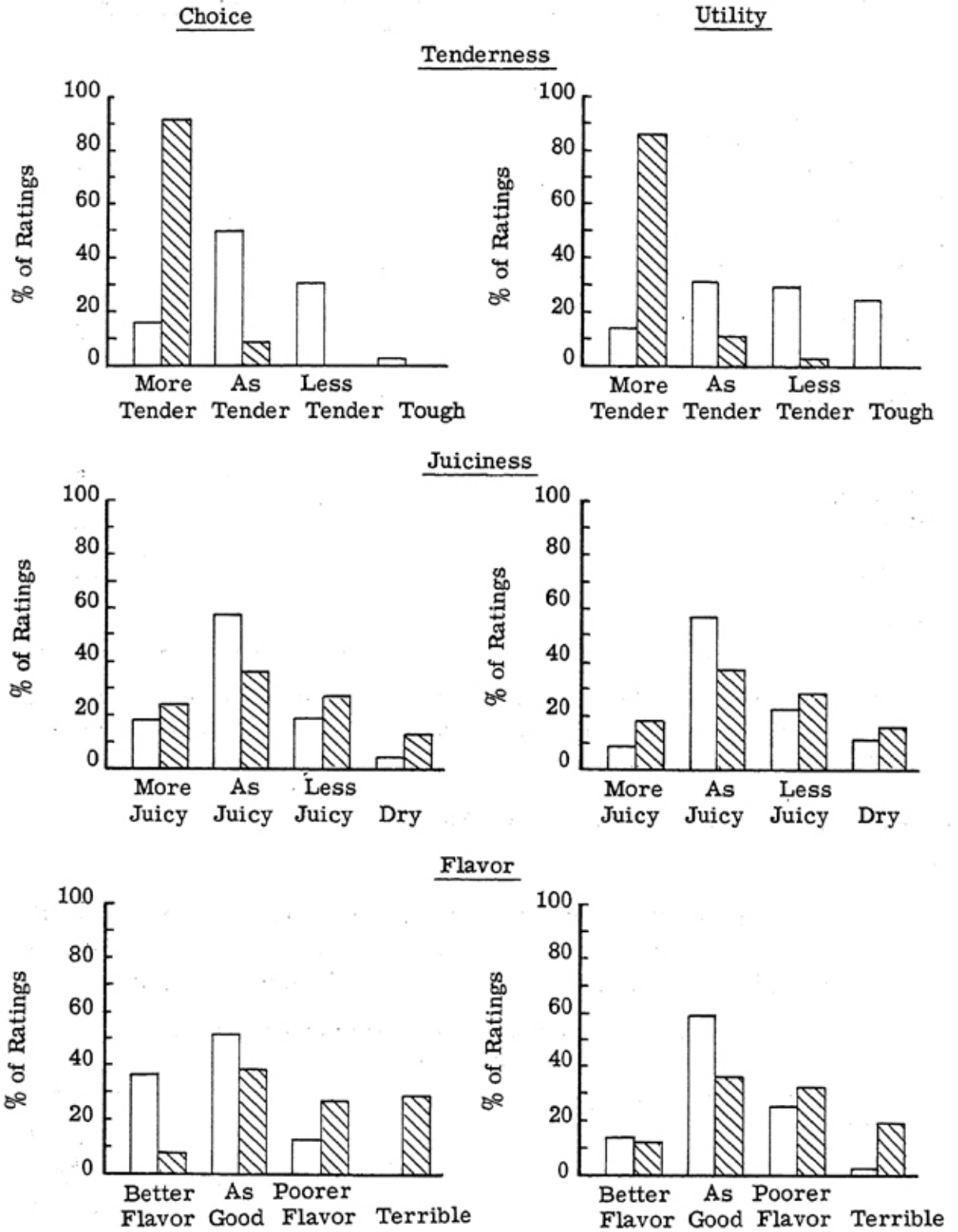


Figure 3.—Sensory ratings for both grades of minute steaks.

TABLE 7--MISCELLANEOUS COMMENTS BY MINUTE STEAK PANEL
BY STAGE AND TREATMENT

Comments	First Stage		Second Stage	
	Control	Tenderized	Control	Tenderized
Tough connective tissue	8	1	3	1
Good color	2	1		
Too thin	3	1		
Tough in spots	7	1	1	
Fell apart when cooked		19		10
Could not eat		9		4
Unsatisfactory	3	3		1
Satisfactory			10	
Texture:				
Strange-unpleasant		5		4
Pasty		3		5
Powdery		3		3
Mealy		9		3
Mushy		9		3
Unlike Meat		5		
Flavor:				
Liver	1	2		
Lacked	3	9	2	5
Unlike beef		2		1
Good	2	1	3	3
Tenderizer:				
Believe one used		2	2	49
Believe one not used			45	3
Uncertain			11	6

the general consensus of the panel. As one panelist aptly put it, "we feel that flavor has been sacrificed for tenderness." Panel members were quite accurate in determining which minute steaks had been tenderized.

Comparison of the Grill and Minute Steak Panels

Acceptability

For the grill panel, the mean ratings for acceptability were superior for the tenderized steaks (Table 8). This was true for both grades, with the greater difference existing between the two treatments of the Utility grill steaks.

TABLE 8--AVERAGE CARCASS MEAN ACCEPTABILITY RATINGS;
BOTH PANELS

Grade and Treatment	Grill Panel	Minute Panel
Choice control	3.23	3.12
Choice tenderized	3.11	5.64
Utility control	3.91	4.16
Utility tenderized	3.22	5.34

Just the opposite was true concerning the acceptability ratings of the minute steak panel. The Choice control and Utility control treatments received ratings greatly superior to those for their tenderized counterparts. And, whereas the greatest improvement by tenderization occurred in the Utility grade of the grill panel, the greatest deterioration by tenderization occurred in the Choice grade of the minute panel.

Tenderness

For each of the panels, the characteristic of tenderness received higher ratings for the tenderized treatments. However, the impact on tenderness was greater on the minute steaks than on the grill steaks (Figures 2 and 3). For the two grades combined, only a negligible percentage of the tenderized minute steaks were rated less tender than average, and none was rated tough, whereas a few grill steaks of each grade were so rated.

Juiciness

It was the general consensus of the grill panel that the tenderized steaks were more juicy than the control treatments of either grade (Figure 2). While a slightly larger percentage considered the tenderized minute steaks more juicy than average, the greatest percentage increase occurred in the two lower classifications for juiciness (Figure 3). For both grades of tenderized minute steaks, more than 40 percent were classed as less juicy than average or as dry.

Flavor

The two panels' judgments for flavor showed even sharper contrast between the two treatments. The tenderized grill steaks received more favorable flavor ratings than the non-tenderized while the tenderized minute steaks received considerably less favorable flavor ratings than the non-tenderized.

It was not uncommon for members of the minute steak panel to be at a loss to describe the flavor of the minute steaks to which an enzymatic tenderizer had been applied.

FINAL SUMMARY SCHEDULE

After all eight deliveries of meat had been made to both panels, the interviewer called on each cooperator for a summary statement of his reactions to the meats used in the experiment.

The questions on the final summary schedule included some of a socio-economic nature as well as those directed to the consumer's reaction to the tenderized meats.

Schedules were gathered from all 30 households comprising the grill panel and from 29 cooperators on the minute steak panel. One family on the minute steak panel withdrew from the experiment at the end of the fourth week because they found it impossible to eat the tenderized product.

Socio-Economic Factors

No effort was made to relate social or economic status to the consumer's reaction because of the small size of the panels. Such information does serve to describe the panels which tested the products, however. The chief differences were that family incomes were generally lower for the minute steak panel and the housewives on that panel were younger (Table 9).

TABLE 9--SOCIO-ECONOMIC FACTORS OF THE PANELS

Factor and Classification	Number of Households	
	Grill Panel	Minute Panel
Family Income:		
Less than \$250	2	2
\$250-499	5	16
\$500-749	10	10
\$750 or more	13	1
Education of Housewife:		
High School	9	8
College	21	21
Age of Housewife:		
20-29	--	19
30-39	12	10
40-49	11	
50-59	3	
60 or over	4	

Cooperators' Reactions to Tenderizer

Previous Use of Tenderizer

More than half of the members of each panel had used a tenderizer prior to this experiment (Table 10). It generally was used only occasionally and on such comparatively cheap cuts as round steaks, arm roasts, and chuck roasts.

TABLE 10--PANELS' OPINIONS AS TO EFFECT OF TENDERIZER

Question	Grill Panel			Minute Panel		
	Yes	No	Uncer- tain	Yes	no	Uncer- tain
Ever used a tenderizer?	18	12	--	15	14	--
Did the use of a tenderizer on these steaks:						
Alter tenderness?	24	3	3	27	2	--
Alter juiciness?	9	16	5	14	10	5
Alter flavor?	11	16	3	20	8	1

The panel members did believe that such an additive could improve the meat if properly applied. Some desired more specific directions for its use, and others mentioned the need for due caution to avoid a less desirable texture.

Only two members of either panel had any reservations about using a tenderizer. Most of those who had not used one had never bothered to purchase any; several others considered it unnecessary for the quality of meats they purchased.

Impact on Tenderness

Grill steak Panel.—Table 10 indicates that a majority of the grill steak panel believed the tenderizer altered the tenderness of the product.

They thought the meat was softer, especially on the surface. One cooperator described it as a "puttiness." A few commented that they would have preferred no mushiness, but on the whole the tenderized steaks were considered quite acceptable.

Minute steak panel.—The panel agreed almost unanimously that the tenderizer affected the tenderness of the minute steaks. Those giving the negative replies added that they were not aware of the effect that could be attributed to a tenderizer.

Frequently the impact was to the point of disintegrating the steaks. Many fell apart in the cooking process.

Impact on Juiciness

Grill steak panel.—Nine members of the grill panel felt certain that the tenderizer altered the juiciness of the steaks; they considered the tenderized steaks to have less body, less natural juice, and observed that a rather watery substance cooked out. Three of the nine described them as being drier than the control treatments. The majority of the panel felt the tenderizer had no effect on this characteristic.

Minute steak panel.—Almost half of the minute panel thought the juiciness of the steaks was altered by the tenderizer. Only one of the group considered the tenderized steaks more juicy than the control. This panel also thought the natural juices to be in lesser quantities when the steaks were tenderized.

Impact on Flavor

Grill steak panel.—Of the 11 members who felt the tenderizer changed the flavor of the grill steaks, only four considered the tenderized steaks less flavorful. These four reported that the tenderized steaks were tasteless compared to the control treatments. The remainder of the 11 thought the flavor was improved. Over half the panel could attribute no change in flavor to the tenderizer.

Minute steak panel.—Even though a majority of the panel felt the flavor of the minute steaks had been altered by the tenderizer, a number felt the different texture made it impossible to judge the flavor. A few commented about a liver taste, but more frequently it was said that the tenderized steaks lacked flavor or had a flavor that was not characteristic of beef.

Several hesitated to say the flavor had been altered but felt, rather, that the undesirable texture masked the flavor of the meat.

General Comments

Grill steak panel.—The majority of the grill panel considered the steaks better than the average round steak, more tender and more flavorful than could be purchased at the market. A few of the steaks were tough in spots.

The panel complained frequently about the dry heat method of cookery that was required for this experiment. Many felt a fairer judgment would have resulted had they been permitted to employ their usual method of cooking.

One family stated the added tenderness was not worth the sacrifice of texture and flavor.

Minute steak panel.—The control treatments of both grades of minute steaks were considered acceptable. They were generally of a good color and fairly good flavor. However, it was the panel's consensus that the tenderized minute steaks were unpalatable. Several cooperators rated them unacceptable. A few felt that all treatments were acceptable even though the texture of the tenderized steaks was less desirable.

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