

THE EFFECT OF END POINT TEMPERATURE, THICKNESS AND SECTION  
ON ACCEPTABILITY OF BROILED PORK CHOPS FROM  
RIGHT AND LEFT LOINS

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by

ZOE ANN HOLMES

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Approved by:



Grayce L. Greig

Major Professor

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## INTRODUCTION

The commonly recommended procedure for cooking pork chops is to brown the surface in fat and braise 25-60 minutes in a covered container (Weir et al., 1962). Pork chops should be cooked to an end point temperature of 185°F or until the color of the pork has changed from pink to gray-white (Brown, 1956). It is commonly recommended that pork chops should not be broiled (Levie, 1963).

Otto and Abrams (1939) observed with in vitro experiments that the trichinae larvae were killed at a temperature of 55°C (131°F). The Manual of Meat Inspection Procedures (U.S.D.A., 1963) requires that pork muscle tissue for commercially sold cooked products be heated to a temperature not lower than 137°F (58.5°C) in order to destroy the Trichina spiralis. This would indicate the possibility of using, with safety, lower end point temperatures for cooking.

According to the literature, the use of broiling as a cooking method for pork has not been extensively investigated. Consequently, the study of broiling pork chops was undertaken. The purpose of this study was to determine the effect of various thicknesses and end point temperatures on the appearance, palatability, cooking time, and cooking losses of broiled center loin, shoulder, and rib pork chops.

## REVIEW OF LITERATURE

## Factors Related to Marbling

The relationship between degree of marbling, moisture and palatability of the pork longissimus dorsi muscle has been frequently investigated. However, workers disagree on whether or not marbling is related to moisture and palatability.

Moisture. It has been observed that, although people like "marbled" pork better, they tend to buy lean pork (Kauffman et al., 1960). Intramuscular fat content in most of the raw pork muscles investigated by Batcher et al. (1962) increased as the marbling scores for the carcasses increased. Moisture of pork muscles also was studied. Muscles from 32 pork carcasses with high marbling scores had low moisture content and those with low marbling scores, high moisture values. The marbling was determined on the longissimus dorsi cut surface between the 10th and 11th rib. This corresponds with the results which Whitehair et al. (1964) observed. Total moisture was found to be inversely related to total fat level in the longissimus dorsi muscle of 400 pork loins picked on the basis of visual marbling scores. Defrosting drip losses decreased ( $P < .01$ ) as finish increased in 75 pork carcasses studied by Saffle and Bratzler (1959). These were divided into 3 groups on the basis of finish.

Palatability. The degree of marbling in the raw longissimus dorsi between the 10th and 11th rib was noted by Batcher and Dawson (1960) to show promise as a means of predicting the

tenderness and juiciness of cooked pork loin. Tenderness, as determined by Warner-Bratzler shear, was favorably influenced by higher amounts of intramuscular fat in the longissimus dorsi (Whitehair et al., 1964). Tenderness and degree of marbling also were found to be directly related ( $P < .05$ ) by Murphy and Carlin (1961) who studied braised  $\frac{1}{2}$ -in. pork chops. Degree of marbling was determined at the 10th rib and 4th lumbar vertebra. Similarly, Harrington and Pearson (1962) observed that tenderness increased with an increase in intramuscular fat in the 36 pork loins studied. With an increase of 1% in intramuscular fat there was a concurrent 0.4 lb decrease in shear value. Kauffman et al. (1964) studied 439 pork loins and observed that tenderness was higher for loins that had higher quantities of fat. Degree of marbling in pork, as identified histologically by Carpenter et al. (1963) indicated that with an increase in marbling there was an increase in tenderness ( $P < .05$ ). Microscopic study showed that as fat increased it infiltrated the connective tissue and this was a possible explanation for the increase in tenderness associated with increase in marbling score.

However, other workers did not indicate a relationship between increased tenderness and increased marbling. Panel tenderness scores were only slightly related to marbling in a study by Henry, Bratzler, and Lueke (1963). Batcher et al. (1962) also found that changes in tenderness (shear force values) were not related consistently to marbling scores. Marbling index as well as intramuscular fat was not associated consistently

with panel tenderness scores. Paired raw and cooked muscles of 32 gilts of known history were studied.

Juiciness scores tended to increase with marbling of pork lean as studied by Onate and Carlin (1963). Muscle marbling of right and left loins from 48 carcasses were scored at the 10th rib. In another study at Iowa State (Murphy and Carlin, 1961), similar positive relationships between marbling and juiciness ( $P < .05$ ) were noted for braised pork chops. Kauffman et al. (1964) observed that higher juiciness ratings were associated with greater quantities of marbling. Similarly, Carpenter and workers (1963) noted that juiciness increased as the amount of fat, which was determined histologically, increased. Work by Batcher et al. (1962) did not support a relationship between juiciness and marbling. They found that juiciness scores were not associated consistently with marbling index or intramuscular fat. However, flavor was found to increase with increasing levels of marbling by both Kauffman et al. (1964) and Carpenter et al. (1963).

#### Variation in Tenderness Within the Longissimus Dorsi

Many investigators have observed variation within the longissimus dorsi muscle from both the anterior to the posterior end and dorsal to the ventral side. This possibility of variation in the principal muscle in the loin necessitates the accounting for this factor in the statistical design.

Shear force values of both the raw and cooked longissimus

dorsi muscle were lower (more tender) near the spine than the outer edge as determined by Onate and Carlin (1963). Paired loins from 48 pork carcasses were used. Variation between the dorsal, medial, and lateral portions of the longissimus dorsi of 97 center cut pork loin roasts cooked to 180°F were investigated by Alsmeyer, Thornton, and Hiner (1965). Slice tenderness evaluations (STE) indicated that the medial areas were tougher than the lateral but tenderness was similar for the dorsal and ventral portions of the longissimus dorsi.

Much research has been done on variation of the longissimus dorsi muscle from the posterior to the anterior end. Longissimus dorsi muscles from 6 hogs were cut into 8 sections and roasted by Weir (1953). She observed that the longissimus dorsi was less tender in its center portion than at either the posterior or the anterior end, with the anterior being more tender than the posterior end. Baird (1960), using 24 left loins divided into 3 portions and roasted (350°F) to an internal temperature of 185°F, observed that posterior cuts had lower shear values (more tender) than either the anterior or center cuts that were similar in tenderness. Tenderness scores, as with Weir's (1953) study, indicated that anterior roasts had higher ( $P < .05$ ) initial tenderness scores than the center portion. Tenderness scores, as noted by Pengilly (1965), of the longissimus dorsi did not vary significantly. She observed that tenderness was slightly greater for the anterior than the middle or posterior section.

Uniformity of shearing strength (tenderness) within 3



paired pork loins was investigated by Mackey and Oliver (1954). One-in. pork chops, cooked in a covered pan (253.4°F) to an internal temperature of 185°F, were observed to differ in respect to tenderness with position of the chop within the loin. However, Gould and workere (1965) found no differences between the position of the chops within the loin with respect to tenderness. They cooked 1-in. chops in deep fat (225°F) to 165°F. Starting at the 10th rib, 6 chops were cut beginning at the anterior and moving toward the posterior end of the loin.

Sectional differences along the loin have been found for juiciness and flavor. Anterior roasts were noted by Baird (1960) to be juicier than posterior or center roasts. Similarly, Batcher and Dawson (1960) observed that anterior had higher juiciness scores than posterior roasts. However, Pengilly (1965) found that juiciness did not vary between anterior and posterior portions of a loin, although, the middle portion of the loin was juicier ( $P < .05$ ) than either end. Baird (1960) noted that the anterior cuts had the highest ( $P < .05$ ) flavor scores and the posterior the lowest. Pengilly (1965) also reported that anterior received higher flavor scores than posterior cuts.

#### Color

Raw pork. Color may be affected by the chemical composition of the meat. Variation in the amount of muscle pigment in pork was found by Topel (1962). In the longissimus dorsi muscle from 52 swine, the posterior ends had greater myoglobin concentration ( $P < .05$ ) and were darker than the anterior sections.

The anterior and center portions of the longissimus dorsi muscles were light in color and similar.

The effect of intramuscular fat level (degree of marbling) and Hunter attributes (reflectance, redness, yellowness) on pre-cooked pork longissimus dorsi was noted by Whitehair and workers (1964) to be unaffected by degree of marbling. However, Saffle and Bratzler (1959) observed that the hue shifted to a more yellow-red range and lightness increased as the degree of finish of the pork increased. It was not determined if the color shift was due to marbling or to other chemical and/or physiological changes. Color was measured on a boned chop cut from the right loin at the 10th rib of 75 pork carcasses. All external fat had been removed from the longissimus dorsi muscle. A disk colorimetry measure and calculation of Munsell notations were made.

Cooked pork. The browning of certain foods in cooking imparts an attractiveness and a desirable flavor. In the browning reaction, melanoidin may be formed as a result of the heating together of sugars and amino acids (Danehy and Pigman, 1951). Reynolds (1963) observed that browning in foods and model systems increased with increasing pH. Glucose-6-phosphate is thought to contribute to browning in meat.

Pearson and workers (1962) noted that raw pork loin chops from different animals varied in degree of brownness when subjected to deep-fat frying or to oven drying. The amount of brown color, as measured spectrophotometrically at 375 mμ wave length, was related to the level of reducing sugars in the

tissues. Color development in buffered solutions was pH-independent with the maximum development of brown color being produced between pH 5.6 and 5.9.

### Influences on Cooking

Little has been published about the effect of thickness and end point temperatures upon palatability and appearance of pork chops, especially with reference to broiling as a cooking method. It is generally known that cooking affects flavor and color of pork. The effect of temperatures and time on tenderness of pork has been investigated (Tuomy and Lechnir, 1964). Initially, the effect of cooking temperature (140, 150, 180, 190, 200, 210°F) was to toughen. It was found that there was little tenderizing of pork as it was held for varying times. At 150°F and above, the products tended to become more tender as held for varying times at 150, 180, 190, 200, or 210°F.

Thickness. In a study by Weir *et al.* (1962),  $\frac{3}{4}$ -in. chops were juicier than  $1\frac{1}{2}$ -in. chops and cooking yields decreased as chop thickness increased. Broiled versus braised chops were more tender and juicier; however, braised chops had more flavor. All chops were braised and broiled to an end point of 185°F. In a study of baked pork chops, total cooking time increased as thickness and end point of the center loin chops increased (Bowers and Goertz, 1965). For 1 and  $1\frac{1}{2}$ -in. rib chops, the cooking times (min/lb and total) as well as cooking losses, were greater with increase in thickness and end point temperature. Brownness and flavor scores were higher for  $1\frac{1}{2}$ -in.

than for  $\frac{3}{4}$  or 1-in. center loin chops.

Oven and end point temperatures. Weir et al. (1963) investigated pork loin (left) roasts cooked at 300, 325, or 400°F compared to pork loin (right) roasts cooked at 350°F and observed that the right pork loin roasts were most tender. However, juiciness was unaffected by oven temperature. For pork chops, broiler air temperatures of 275, 350, and 425°F (4 in. below the broiler unit) were used in a study by Weir and workers (1962). Generally, the palatability of the chops was unrelated to broiler air temperature; however, the higher temperatures did cause increased cooking losses.

In a study investigating the effect of end point and thickness upon broiled rib, center loin, and shoulder pork chops, end point temperature was observed to affect their acceptability (Bowers and Goertz, 1965). With 1-in. center loin and  $\frac{3}{4}$ -in. rib chops, better flavor scores were obtained at an end point of 185 rather than 170°F. Flavor scores, with  $1\frac{1}{2}$ -in. center loin chops were better for an end point of 170°F than for chops broiled to either 155 or 185°F. However, 1-in. rib chops had similar flavor scores at 170 and 185°F, both of which were higher ( $P < .05$ ) than chops broiled to 155°F (Goertz, 1964). Juiciness was found to decrease as end point temperature increased in rib chops ( $\frac{3}{4}$ ,  $\frac{1}{2}$ , 1,  $1\frac{1}{2}$ -in.). One-in. shoulder and 1 and  $\frac{1}{2}$ -in. center loin chops were browner at 185 than at 170°F (Bowers and Goertz, 1965). Cooking time and cooking losses increased as end point temperature increased in  $\frac{1}{2}$  (170, 185°F),  $\frac{3}{4}$  (170, 185°F), and

1-in. (155, 170, 185°F) rib and center loin chops.

Roasts cooked to 185°F, had lower juiciness scores but higher odor scores than 170°F roasts (Weir et al., 1963). Webb and workers (1961) observed pork loin roasts cooked to 185, 165, and 155. A fourth group of roasts were cooked to 155°F and held at that end point temperature for 1 hr. For all groups tenderness was lower as the internal temperature increased. Also, flavor scores, cooking time, and total cooking losses increased as internal temperature increased. Pengilly (1965), in a study of 36 pork loin roasts cooked to end point temperatures of 149, 167, and 185°F, observed that juiciness decreased ( $P < .05$ ) and reflectance values increased as end points increased. pH of cooked meat was unaffected by end point temperatures.

#### PROCEDURE

Fourteen paired pork loins of average quality (No. 3) were selected at Maurer Neuer Inc. at Arkansas City and shipped to Kansas State University. From these, 12 pairs were selected. Pork loins were weighed and broken at the last rib into a loin and rib portion. The anterior end of each loin section was graded for color, firmness and marbling using the Wisconsin 5 point scale (Department of Meat and Animal Science, 1963). The longissimus dorsi muscle was traced for determination of surface area. The center loin then was separated from the loin end at the anterior point of the hip bone. Loin ends were not used in this study. Rib sections were separated from the

shoulder between the 7th and 8th rib, thus obtaining a shoulder section having 5 ribs. All sections were blast frozen at  $-20^{\circ}\text{C}$ . Following cutting, the chops for each cooking period were coded, wrapped in heavy gauge aluminum foil (.0015-in.), and stored at  $0^{\circ}\text{F}$ . The packaged  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin, rib, and shoulder chops were defrosted 24 hours at  $40^{\circ}\text{F}$  and the 1 and  $1\frac{1}{2}$ -in. center loin and rib chops 36 hours, to an internal temperature of approximately  $50^{\circ}\text{F}$ . Prior to cooking, the backfat was trimmed to  $1/8$ -in. thick.

#### Preliminary Study

An extensive preliminary study was used to determine broiling procedures, and appropriate end points, thicknesses, and turning times for shoulder, center loin, and rib chops (Goertz, 1964 and Bowers and Goertz, 1965).

Comparison of chops cut from fresh unfrozen and from frozen loin portions indicated that the latter were more uniform in thickness and had less distortion. Thus, for the main study all chops were cut from frozen sections.

Standard and modified broiling methods were used for  $\frac{1}{2}$ ,  $\frac{3}{4}$ , 1, and  $1\frac{1}{2}$ -in. rib chops. For modified broiling, chops were placed on an inverted U-shaped rack with the top surface 4-in. from the bottom of the pan and broiled in a rotary hearth gas oven at  $500^{\circ}\text{F}$ . Standard broiling involved use of the oven of an electric range preheated on broil for 30 min with the door ajar. It was necessary to have the surface of the meat approxi-

mately 11 in. from the broiling unit, otherwise the chops were too brown before the desired end point temperature was reached. The rib chops broiled by the modified method were similar to baked chops; thus, the modified method of broiling was not used for center loin and shoulder preliminaries.

End point temperatures of 155, 170, and 185°F were used for  $\frac{1}{8}$ ,  $\frac{3}{8}$ , and 1-in. shoulder, rib, and center loin chops. The 3 end point temperatures also were used for  $1\frac{1}{2}$ -in. rib and center loin chops. Palatability factors (tenderness, juiciness, and flavor) of the center loin and shoulder chops were similar when broiled to 170 and 185°F; therefore, 185°F was not repeated for chops in the present study.

In addition to end point temperatures, end point time (min) also was used in the broiling of  $\frac{1}{2}$  (18 min), 1 (16, 23, and 26 min), and  $1\frac{1}{2}$ -in. (33 min) center loin chops. Preliminary work on end point time for  $\frac{1}{2}$  and  $1\frac{1}{2}$ -in. chops indicated the specific times that an evenly browned chop could be obtained. However, the 16, 23, and 26 min corresponded more closely to 155 and 170°F than 170 and 185°F, respectively. The  $1\frac{1}{2}$ -in. center loin chops broiled 33 min were similar to those cooked to 170°F. Because preliminary data indicated optimum time corresponded closely to a specific end point, temperatures were used in the main study.

### Main Study

Cooking method. Shoulder, center loin, and rib chops of various thicknesses were cooked to selected end points (Table 1).

Table 1. Thickness, end point temperature, and turning time of broiled center loin, rib, and shoulder pork chops.

	Thickness (in.)	End point temperature (°F)	Turning time (min)
Center loin	$\frac{1}{2}$	170	6.0
	$\frac{3}{4}$	170	6.0
	1	155	6.0
		170	9.0
	$1\frac{1}{2}$	155	12.0
		170	13.0
Rib	$\frac{1}{2}$	170	6.0
		185	6.0
	$\frac{3}{4}$	170	8.0
		185	8.0
	1	155	6.0
		170	9.5
		185	13.0
	$1\frac{1}{2}$	155	13.0
	170	13.5	
	185	19.0	
Shoulder	$\frac{1}{2}$	170	6.5
	$\frac{3}{4}$	170	8.0



The turning time during broiling was determined by preliminary study (Goertz, 1964; Bowers and Goertz, 1965).

The oven of an electric range was preheated on "Broil" for 30 min with the door ajar. An open wire rack was used and was approximately 11 in. from the broiling unit and 2 in. from the bottom of an open aluminum pan. Oven air temperature (approximately 345°F) was recorded in close proximity and at the same level as that of the meat.

An experimental multipoint recorder by Taylor Instrument Company equipped with copper-constantan thermocouples was used for recording the oven air and internal temperature of the meat. The thermocouples were placed in the center of the longissimus dorsi muscle, along the center of the blade bone of the shoulder chops, and at the junction of the rib and/or backbone in some chops.

Experimental design and analyses. Paired loins were cut and cooked according to a modified randomized block design. Right and left loins from the same carcass were cut similarly. Analyses of variance of selected factors were determined with temperatures (155, 170, and 185°F) and thickness (1 and 1½-in.) as sources of variation for rib chops, thickness (½, ¾, 1, and 1½-in.) for loin chops, and for sectional comparison of temperature for 1 and 1½-in. 155 and 170°F rib and center loin chops and section for ½ and ¾-in. 170°F center loin, rib, and shoulder chops.

"t" tests were run to determine differences related to thickness (½ and ¾-in.) of center loin, rib, and shoulder chops

at 170°F and of rib at 185°F. Also, "t" tests were run to determine the effect of increasing end point temperature from 155 to 170°F for both 1 and 1½-in. loin chops. To determine similarity of left and right center loin and rib chops, "t" tests were determined for cooking losses (%), total cooking time (min), and chop weights for each thickness and end point temperature. Sectional differences between center loin and rib chops for total moisture (%), cooking losses (%), total cooking time (min), and Gardner color difference meter values were studied by the use of the "t" test. Standard errors were calculated for color, firmness and marbling scores, longissimus dorsi muscle area (cm<sup>2</sup>), and weights of the raw loins. Detailed data for analyses of selected factor is in Appendix Tables.

Subjective evaluations. A panel of 5 experienced judges used a 7-point scale for scoring degree of tenderness, doneness, juiciness, and flavor desirability of ½ x ½-in. cores from the broiled chops of the right loin. Warm samples were tasted as soon as possible after broiling (Form 1, Appendix).

The appearance of the whole broiled chop was determined on cuts taken from the left loin. Each chop was judged for amount of coagulum on side 2 and for degree and uniformity of brownness on side 1 (initial side up on rack) and side 2 (initial side down on rack) (Form 2, Appendix).

Objective measurements. Objective measurements were made on the defrosted raw and cooked longissimus dorsi muscle. Gardner color difference meter values were determined for the

raw pork chops (right and left loin) immediately prior to broiling. Following broiling, Gardner color difference meter readings were taken on both surfaces of the broiled chops from the left loin. Also, pH values were run on cooked meat (surfaces removed) from the left loin. Total moisture and shear values ( $\frac{1}{2}$ -in. cores) were measured for samples obtained from broiled chops from the right loin. Total cooking losses, cooking times (total and min/lb) and rate of heat penetration (multipoint recorder) were determined on each chop. All tests were made on the same day of cooking.

For determination of Gardner color difference meter values, uncooked whole or thin slices of sides 1 and 2 of cooked chops (browned surface face down) were used to obtain the reflectance (Rd), redness (+a), and yellowness (+b) values. For both raw and cooked chops, a pink tile with a satin finish was used to standardize the reflectance (37.64), yellowness (+6.21), and redness (+14.98) values. One shear was made on two  $\frac{1}{2}$ -in. cores of each variable on a Warner-Bratzler shearing apparatus (25 lb dynamometer).

The longissimus dorsi of each chop from the right and left loin was ground through an electric grinder for determination of both pH and total moisture respectively. A Kenmore (No. 8202) electric food grinder with fine plate was used. The pH of the cooked meat samples was determined with a Model 76 expanded scale pH meter by Beckman Instruments, Inc. A homogenate (5 g ground meat to 50 ml distilled water) was blended for 2 min on high speed in a Waring Blendor. The meter was standardized

by the use of a standard buffer (pH 6.86). Triplicate readings were determined on the homogenate sample which was kept agitated with a magnetic stirrer. Total moisture of cooked ground meat was determined by use of the C. W. Brabender semi-automatic rapid moisture tester. Duplicate samples (5 g) were dried at 121°C for 90 min.

## RESULTS AND DISCUSSION

### Factors Related to Juiciness

The effect of end point temperature or thickness upon juiciness as evaluated by a trained panel was investigated. Also, related objective measurements including cooking losses (%), total moisture (%), and total cooking time (min) were determined (Table 2).

Generally, higher juiciness scores were obtained with increasing thickness from  $\frac{1}{2}$  to  $\frac{3}{4}$ -in. center loin, shoulder and rib chops. In a comparison of  $\frac{3}{4}$  and  $1\frac{1}{2}$ -in. chops, Weir et al. (1962) also observed that thicker chops were juicier. In the study reported here, center loin and rib chops of the same thickness decreased in juiciness with higher end point temperatures. The 1-in. rib chops were less juicy ( $P < .05$ ) at 185°F than at 155 or 170°F and the  $1\frac{1}{2}$ -in. center loin chops less juicy ( $P < .05$ ) at 170 than at 155°F. Similarly, pork roasts juiciness scores were found to decrease with increase in temperature by Weir and workers (1962) and Pengilly (1965).

Total moisture tended to increase as thickness increased

Table 2. Juiciness scores, cooking losses (%), total moisture (%), and total cooking time (min) of center loin, shoulder, and rib chops.<sup>1</sup>

Group	Treatment			Juiciness	Total moisture	Cooking losses		Total cooking time	
		°F	in.			Left	Right	Left	Right
I	Center loin	170	1/4	5.8	64.3	21.5	19.6	9.5	9.4
			3/4	6.1	65.5	24.7	21.7	12.5	14.4
II	Shoulder	170	1/4	4.8	----	27.3	30.2	16.8	17.5
			3/4	5.4	----	25.1	29.0	20.7	24.2
III	Rib	170	1/4	5.1	60.7	22.0	22.1	9.6	9.3
			3/4	5.2	62.3	23.3	25.1	15.7	16.25
IV	Rib	185	1/4	4.6	55.4	28.0	30.4	13.9	12.8
			3/4	5.0	60.4	27.7	28.7	18.25	17.2
V	Center loin	155	1	6.0	64.1	24.4	21.6	18.3	19.2
		170		5.6	63.7	25.3	25.6	22.8	23.0
VI	Rib	155	1	5.7	64.3	23.2	23.5	14.1	15.4
		170		5.5	62.5	27.2	27.8	18.3	18.4
		185		5.0	59.8	33.3	33.4	24.8	17.1
LSD*				0.5	2.8	----	----	4.7	----

VII	Center loin	155	1 $\frac{1}{2}$	5.5	62.3	23.0	25.4	27.2	29.0
		170		4.9	62.0	28.3	31.0	28.0	29.0
VIII	Rib	155	1 $\frac{1}{2}$	5.6	64.0	24.6	24.1	23.6	25.4
		170		5.5	62.4	28.4	25.4	29.6	27.8
		185		5.2	58.6	26.0	32.3	36.2	32.2
	LSD*			---	3.8	----	----	0.2	----

<sup>1</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

LSD\* least significant difference ( $P < .05$ ).

( $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin and rib chops) and decrease as temperature increased (1 and  $1\frac{1}{2}$ -in. center loin and rib chops). The  $\frac{3}{4}$ -in. rib chops cooked to  $185^{\circ}\text{F}$  had higher moisture values ( $P < .05$ ) than the  $\frac{1}{2}$ -in. chops. Total moisture values were less ( $P < .05$ ) at  $185$  than at  $155^{\circ}\text{F}$  for 1-in. and  $155$  or  $170^{\circ}\text{F}$  for  $1\frac{1}{2}$ -in. rib chops.

Cooking losses were slightly greater with  $\frac{1}{2}$  to  $\frac{3}{4}$ -in. rib and center loin chops ( $170^{\circ}\text{F}$ ) and less with  $\frac{1}{2}$  to  $\frac{3}{4}$ -in. shoulder ( $170^{\circ}\text{F}$ ) and rib ( $185^{\circ}\text{F}$ ) chops. Generally, cooking losses tended to be higher as end point temperature increased for the 1 and  $1\frac{1}{2}$ -in. center loin and rib chops. For 1-in. (right) and  $1\frac{1}{2}$ -in. (right and left) center loin chops, cooking losses were higher ( $P < .05$ ) for chops broiled to  $170^{\circ}\text{F}$  than to  $155^{\circ}\text{F}$ . These results are in agreement with the preliminary study where cooking losses increased with thickness (Bowers and Goertz, 1965). These workers also observed that cooking losses increased as end point temperature increased in the 1 (155, 170,  $185^{\circ}\text{F}$ ) and  $1\frac{1}{2}$ -in. (155, 170,  $185^{\circ}\text{F}$ ) rib and center loin chops. Webb and workers (1961) also found a similar relationship with pork loin roasts.

In general, total cooking time (min) for the left and right loin increased as thickness or end point temperature increased. Total cooking time increased with thickness ( $P < .01$ ) for right and left shoulder ( $170^{\circ}\text{F}$ ) and rib (170 and  $185^{\circ}\text{F}$ ) and for the right center loin ( $170^{\circ}\text{F}$ ). There were longer total cooking times obtained with 1-in. left center loin at 170 than at  $155^{\circ}\text{F}$

( $P < .01$ ) and with the 1-in. rib at  $185^{\circ}\text{F}$  than at  $155$  or  $170^{\circ}\text{F}$  ( $P < .05$ ). The total cooking time increased ( $P < .05$ ) among end point temperatures with  $1\frac{1}{2}$ -in. left rib chops ( $155$ ,  $170$ ,  $185^{\circ}\text{F}$ ). Preliminary study also indicated that total cooking time increased as thickness and end point temperature increased for rib, shoulder, and center loin chops (Bowers and Goertz, 1965).

Thus, juiciness scores, total moisture, cooking losses, and total cooking times tended to increase with thickness. With higher end point temperatures, juiciness scores and total moisture were lower, cooking losses were greater and total cooking time longer.

#### Tenderness Scores and Shear Values

Tenderness scores and Warner Bratzler shear values for  $\frac{1}{2}$ -in. cores are presented in Table 3. Tenderness scores tended to decrease for center loin ( $170^{\circ}\text{F}$ ) and rib chops ( $170$  and  $185^{\circ}\text{F}$ ) and increase for shoulder ( $170^{\circ}\text{F}$ ) chops as thickness increased from  $\frac{1}{2}$  to  $\frac{3}{4}$ -in. In a comparison of  $\frac{3}{4}$ , 1 and  $1\frac{1}{2}$ -in. broiled rib chops, Weir, et al. (1962) also observed that thinner chops were more tender. In the present study, tenderness scores and shear values were not affected by increasing end point temperatures for 1 and  $1\frac{1}{2}$ -in. center loin ( $155$  and  $170^{\circ}\text{F}$ ) and rib ( $155$ ,  $170$ ,  $185^{\circ}\text{F}$ ) chops. However, in a study of pork loin roasts, Webb and workers (1961) found that tenderness decreased as internal temperature increased from  $155$  to  $165$  to  $185^{\circ}\text{F}$ . However in this study, tenderness scores and shear values were



Table 3. Tenderness, flavor, doneness, and coagulum scores, and shear ( $\frac{1}{2}$ -in. cores) and pH values.<sup>1</sup>

Group	Treatment			Tenderness	Shear values	Flavor	Doneness	Coagulum	pH
		$^{\circ}$ F	in.						
I	Center loin	170	$\frac{1}{2}$	6.0	---	5.3	5.5	4.7	5.90
			$\frac{3}{4}$	5.8	---	5.5	5.4	4.0	5.93
II	Shoulder	170	$\frac{1}{2}$	5.8	---	5.3	5.6	5.4	----
			$\frac{3}{4}$	6.0	---	5.2	5.6	6.3	----
III	Rib	170	$\frac{1}{2}$	6.3	---	5.5	5.6	4.6	6.01
			$\frac{3}{4}$	6.0	---	5.6	5.5	5.3	6.03
IV	Rib	185	$\frac{1}{2}$	6.1	---	5.4	5.3	5.1	6.05
			$\frac{3}{4}$	5.9	---	5.5	5.5	5.2	6.07
V	Center loin	155	1	6.5	7.9	5.6	5.4	4.4	5.96
		170		6.1	6.8	5.8	5.4	3.9	6.01
VI	Rib	155	1	6.2	6.2	5.5	5.7	5.6	5.85
		170		6.2	7.6	5.5	5.7	4.3	5.86
		185		6.1	7.6	5.7	5.9	3.9	5.87
	LSD*			---	---	---	---	1.2	----

VII	Center loin	155	1½	5.9	5.6	5.8	5.7	4.7	5.77
		170		6.1	5.5	5.8	5.5	4.3	5.85
VIII	Rib	155	1½	6.2	5.9	5.8	5.8	4.6	5.97
		170		6.2	6.7	5.9	5.9	5.0	6.00
		185		6.3	5.9	6.0	5.8	3.8	5.96

<sup>1</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

LSD\* least significant difference ( $P < .05$ ).

not affected by thickness or temperature.

#### Flavor, Doneness, and Coagulum Scores, and pH Values

Flavor and doneness scores did not vary for either end point temperature or thickness (Table 3). With increasing thickness, flavor scores increased slightly for  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin (170°F) and rib (170 and 185°F) but decreased slightly for shoulder (170°F) chops. An increase in flavor with thickness in center loin chops also was reported by Bowers and Goertz, 1965, who indicated that flavor scores increased with thickness from  $\frac{3}{4}$  to 1 to  $1\frac{1}{2}$ -in. chops. Although in the present study, rib and center loin flavor scores were occasionally similar with end point temperature increases (1-in., 155 and 170°F), flavor tended to become slightly higher with increase in end point temperatures. Webb and workers (1961) also observed that flavor of pork loin roasts increased as internal temperatures increased. The present results are in disagreement with the preliminary study in which 1-in. broiled rib chops had similar flavor scores at 170 and 185°F, both of which were higher ( $P < .05$ ) than chops broiled to 155°F (Bowers and Goertz, 1965). However, higher flavor scores for 1-in. center loin and  $\frac{1}{2}$ -in. rib chops were obtained at an end point temperature of 185 rather than 170°F in the preliminary study.

With the exception of  $1\frac{1}{2}$ -in. rib chops (170°F), coagulum scores tended to decrease with increasing temperature (Table 3). Since higher coagulum scores indicated less coagulum, amount of coagulum increased with end point temperature. Amount of

coagulum increased significantly for the 1-in. rib (155 to 185°F) but coagulum scores were unrelated to thickness.

Generally, pH tended to increase with increase in thickness for  $\frac{1}{2}$  to  $\frac{3}{4}$ -in. center loin (170°F) and rib chops (Table 3). Also, pH increased slightly with increase in end point except for  $1\frac{1}{2}$ -in. rib chops cooked to 185°F. However, these increases in pH values were not significant. This concurs with results by Pengilly (1965) who observed that pH was not significantly affected by end point temperatures in pork loin roasts.

Flavor, doneness and coagulum scores or pH values of broiled pork chops were not affected significantly by thickness or end point temperatures. However, flavor scores tended to increase slightly with increasing temperature or thickness. On the whole, coagulum scores decreased indicating increased amounts of coagulum with increasing temperatures.

#### Factors Related to Color

The effect of end point temperature or thickness upon color of the chop was investigated. Reflectance (Rd) by the Gardner color difference meter (Table 4) and degree and uniformity of brownness (Table 5) were determined by a trained panel.

No consistent trend was noted for reflectance (Rd) for the raw chops. This would indicate uniformity of raw samples and that any trend which occurred for reflectance for the broiled chops, was attributable to the treatments of temperature or thickness. Although no significant differences were found for broiled chops, reflectance for side 1 tended to decrease

Table 4. Gardner color difference meter values (Rd) of broiled and raw center loin, shoulder, and rib chops.<sup>1</sup>

Group	Treatment	°P	in.	Raw		Broiled	
				Side 1	Side 2	Side 1	Side 2
I	Center loin	170	$\frac{1}{2}$	18.70	18.68	25.05	31.64
			$\frac{3}{4}$	19.79	18.42	22.72	27.17
II	Shoulder	170	$\frac{1}{2}$	-----	-----	-----	-----
			$\frac{3}{4}$	-----	-----	-----	-----
III	Rib	170	$\frac{1}{2}$	18.73	19.26	29.22	30.48
			$\frac{3}{4}$	18.73	18.65	27.82	32.05
IV	Rib	185	$\frac{1}{2}$	19.11	19.01	29.22	30.48
			$\frac{3}{4}$	18.82	19.11	27.87	31.50
V	Center loin	155	1	15.97	17.15	21.82	23.25
		170		16.74	17.18	21.64	22.05
VI	Rib	155	1	19.20	19.66	30.45	32.12
		170		20.39	19.04	31.52	30.95
		185		19.85	19.44	24.06	19.20
	LSD*			-----	-----	-----	7.20

VII	Center loin	155	1 $\frac{1}{2}$	19.06	18.93	24.62	25.09
		170		21.64	19.70	24.12	20.11
VIII	Rib	155	1 $\frac{1}{2}$	18.16	18.75	23.54	25.93
		170		16.65	18.37	24.28	29.27
		185		20.31	17.99	25.62	20.73

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<sup>1</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

LSD\* least significant difference ( $P < .05$ ).

Table 5. Uniformity and degree of brownness scores of center loin, shoulder, and rib chops.<sup>1</sup>

Group	Treatment			Degree of Brownness		Uniformity of Brownness	
		°P	in.	Side 1	Side 2	Side 1	Side 2
I	Center loin	170	½	3.5	3.8	5.6	5.1
			¾	4.2	3.9	4.8*	5.0
II	Shoulder	170	½	5.4	4.9	4.9	5.1
			¾	4.8	4.0	4.7	5.3
III	Rib	170	½	2.6	2.3	6.0	5.6
			¾	2.9	3.5	5.8	5.1
IV	Rib	185	½	2.5	3.5	6.2	4.4
			¾	2.9	3.8	5.9	4.2
V	Center loin	155	1	4.0	2.4	4.4	5.9
		170		4.3	4.0	5.5*	5.1*
VI	Rib	155	1	3.8	4.2	4.8	4.9
		170		4.3	4.4	4.7	4.5
		185		5.4	5.5	3.9	3.7
	LSD*			0.9	---	0.8	---
VII	Center loin	155	1½	4.9	4.6	5.3	4.8
		170		5.0	6.3**	5.0	2.9**
VIII	Rib	155	1½	4.5	4.2	5.1	4.0
		170		5.0	4.3	4.4	4.1
		185		6.2	5.2	5.0	4.2
	LSD*			0.5	---	---	---

<sup>1</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

LSD\* least significant difference ( $P < .05$ ).

(became browner) with increase in thickness for the center loin and rib chops. Reflectance for side 2 tended to increase with increasing thickness for the broiled rib ( $\frac{1}{2}$  to  $\frac{3}{4}$ -in.) chops. With increasing temperature, center loin chops (1 and  $1\frac{1}{2}$ -in.) had a decrease in reflectance. At  $185^{\circ}\text{F}$ , reflectance values were significantly less than at  $170$  and  $155^{\circ}\text{F}$  for 1-in. broiled rib chops. Otherwise, there were no significant differences or consistent trends between reflectance and end point temperatures of rib chops.

An increase in degree of brownness score indicated a more intense brown colored chop. For  $170^{\circ}\text{F}$   $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin and rib chops (side 1 and 2), degree of brownness tended to increase and for shoulder chops to decrease (side 2,  $P < .05$ , and side 1) as thickness increased (Table 5). This agrees with the preliminary study in which browning scores also were higher for  $1\frac{1}{2}$ -in. than for  $\frac{3}{4}$  or 1-in. center loin chops (Bowers and Goertz, 1965). With increase in temperature, chops became browner. One-in. rib chops (side 1) broiled to  $155$  and  $170^{\circ}\text{F}$  were significantly lighter colored than those broiled to  $185^{\circ}\text{F}$ . For side 1 of  $1\frac{1}{2}$ -in. rib chops, with increasing temperatures from  $155$  to  $170$  to  $185^{\circ}\text{F}$ , scores became higher ( $P < .05$ ). Side 2 for  $1\frac{1}{2}$ -in. center loin chops was browner ( $P < .05$ ) at  $170$  than  $155^{\circ}\text{F}$ . The turning time of the chop influenced the similarity of the degree of brownness for side 1 and 2.

The uniformity of brownness, with the exception of side 2 of the shoulder chops, decreased as thickness increased with rib, center loin, and shoulder chops (side 1 and 2). The



decrease was significant for side 1 of the center loin ( $\frac{1}{2}$  and  $\frac{3}{4}$ -in. 170°F) chops. Consistent trends for uniformity of brownness were not observed with increasing temperature. With 1-in. center loin chops the uniformity of brownness increased ( $P < .05$ ) for side 1 and decreased ( $P < .05$ ) for side 2 with increasing temperature from 155 to 170°F. However, for 1-in. rib chops (side 1), uniformity of brownness scores were lower ( $P < .05$ ) at 185°F than at 155 or 170°F. For side 2,  $1\frac{1}{2}$ -in. center loin chops brownness uniformity decreased ( $P < .01$ ) with an increase in temperature of 155 to 170°F.

In general, reflectance values and degree of brownness scores indicated that chops became browner with increasing thickness (center loin and rib) and end point temperature (center loin). Uniformity of brownness usually decreased with increase in thickness. For ribs, no consistent trends were observed for reflectance or uniformity of brownness with increasing end point temperatures.

#### Effect of Thickness

The effect of increasing thickness on selected factors was determined for the center loin and rib chops (1,  $1\frac{1}{2}$ -in.) at 155°F, center loin and rib ( $\frac{1}{2}$ ,  $\frac{3}{4}$ , 1,  $1\frac{1}{2}$ -in.) at 170°F, and rib chops ( $\frac{1}{2}$ ,  $\frac{3}{4}$ , 1,  $1\frac{1}{2}$ -in.) at 185°F. Total cooking time (min), cooking losses (%), and total moisture (%) data are presented in Table 6. Gardner color difference meter values of thickness comparisons are presented in Table 7.

Total cooking time consistently increased with increasing

Table 6. Total cooking time (min), cooking losses (%), and total moisture (%) for broiled center loin and rib chops of varying thicknesses.<sup>1,2</sup>

Treatments		Total cooking time	Cooking losses	Total moisture
Rib	155°F	1-in. 14.8 **	23.4	64.3
		1½-in. 24.5	24.3	64.0
Center loin	155°F	1-in. 18.8 *	23.0	64.1
		1½-in. 28.0	24.2	62.3
Center loin	170°F	½-in. 9.5	20.6	64.3
		¾-in. 13.5	23.2	65.5
		1-in. 22.9	25.4	63.7
		1½-in. 28.5	29.7	62.0
		LSD*	3.8	2.9
Rib	170°F	½-in. 9.4	22.0	60.7
		¾-in. 16.0	24.2	62.3
		1-in. 18.4	27.5	62.5
		1½-in. 28.7	26.9	62.4
		LSD*	2.5	4.1
Rib	185°F	½-in. 13.4	29.2	55.4
		¾-in. 17.7	28.1	60.4
		1-in. 20.6	33.4	59.8
		1½-in. 34.2	29.2	58.6
		LSD*	3.2	----

<sup>1</sup>"t" tests determined for rib (155°F) and center loin (155°F) analyses of variance for all other groups.

<sup>2</sup>Averages of left and right loin were used for statistical determinations.

LSD\* least significant difference ( $P < .05$ ).

Table 7. Gardner color difference meter values of broiled center loin and rib chops of varying thicknesses.<sup>1,2,3</sup>

Treatments			Rd	a	+b
	°F	in.			
Rib	155	$\frac{1}{8}$	31.28 **	+1.03	21.20 **
		$\frac{3}{8}$	24.73	+1.83	13.74
Center loin	155	$\frac{1}{8}$	22.53	+2.49	11.93
		$\frac{3}{8}$	24.85	+2.17	13.15
Center loin	170	$\frac{1}{8}$	28.05	+3.25	11.44
		$\frac{3}{8}$	24.95	+7.79	12.77
		1	21.85	+3.40	12.96
		$1\frac{1}{8}$	22.12	+1.03	14.11
		LSD*	4.57	----	1.27
Rib	170	$\frac{1}{8}$	30.56	+1.22	12.68
		$\frac{3}{8}$	29.94	+0.47	14.04
		1	31.23	-0.85	21.50
		$1\frac{1}{8}$	26.78	+0.77	15.07
LSD*	2.92	----	3.59		
Rib	185	$\frac{1}{8}$	29.86	-0.22	12.71
		$\frac{3}{8}$	29.69	+0.66	13.80
		1	21.60	+2.10	20.20
		$1\frac{1}{8}$	22.56	+3.83	11.98
LSD*	5.86	----	2.82		

<sup>1</sup> See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup> "t" tests determined for rib (155°F) and center loin (155°F), analyses of variance for all other groups.

<sup>3</sup> Averages of side 1 and 2 were used for statistical determination.

LSD\* least significant difference ( .05).

thickness (Table 6). All values were significant with thickness with the rib chops broiled to 155°F, highly significant. The center loin chops at 170°F increased in total cooking time ( $P < .05$ ) from  $\frac{1}{2}$  to  $\frac{3}{4}$  to 1 to  $1\frac{1}{2}$ -in. The rib chops at 170 and 185°F had higher total cooking time ( $P < .05$ ) as thickness increased, except for the  $\frac{3}{4}$  to 1-in. increment. These results concur with the preliminary study in which total cooking time increased with increasing thickness (Bowers and Goertz, 1965).

Cooking losses, with the present study, increased with increased thickness for all comparisons with two exceptions. The  $1\frac{1}{2}$ -in. rib chops at 170 and 185°F indicated smaller losses than the 1-in. chops. With the center loin chops at 170°F, cooking losses of the  $\frac{1}{2}$ -in. chops were lower ( $P < .05$ ) than 1-in. chops which were lower ( $P < .05$ ) than  $1\frac{1}{2}$ -in. chops. Generally, these results can be related to those found by Weir and workers (1962) who observed that cooking yields decreased as chop thickness increased from  $\frac{3}{4}$  to  $1\frac{1}{2}$ -in. chops. Preliminary study also illustrated that cooking losses increased with thickness (Bowers and Goertz, 1965). In the present study, total moisture values decreased with the 1 to  $1\frac{1}{2}$ -in. increment for all rib and center loin chops. However, total moisture was not significantly affected by thickness.

Reflectance (Rd) and yellowness (+b) decreased ( $P < .01$ ) for rib chops (155°F) and increased slightly for center loin (155°F) with increase in thickness from  $\frac{1}{2}$  to  $\frac{3}{4}$ -in. (Table 7). Center loin chops at 170°F had a higher ( $P < .05$ ) reflectance value with  $\frac{1}{2}$ -in. chops than 1 or  $1\frac{1}{2}$ -in. chops, but yellowness (+b) with

$\frac{1}{2}$ -in. chops was less ( $P < .05$ ) than  $\frac{3}{4}$ -in. chops which was less ( $P < .05$ ) than  $1\frac{1}{2}$ -in. chops. One and one-half in. rib chops had less reflectance than the  $\frac{1}{2}$ ,  $\frac{3}{4}$ , or 1-in. rib chops ( $170^{\circ}\text{F}$ ). The yellowness was significantly higher for the 1-in. than  $\frac{1}{2}$ ,  $\frac{3}{4}$ , or  $1\frac{1}{2}$ -in. rib chops. Redness (+a) was similar and unrelated to thickness.

This study indicated a tendency for reflectance and yellowness to decrease for rib chops and increase slightly with center loin chops for progressively thicker chops. Redness appeared to be unaffected by thickness.

#### Comparison of Rib, Center Loin, and/or Shoulder Chops

The effect of section (rib, center loin, and/or shoulder) upon total moisture (%), total cooking time (min), cooking losses (%), and Gardner color difference meter value of broiled chops was investigated. Data for these comparisons are presented in Table 8.

The study here indicated that the particular section from which a chop was obtained influenced the results for the selected data used. Comparison of the rib, center loin, and shoulder sections indicated that total cooking time and cooking losses were higher ( $P < .05$ ) with the  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. shoulder sections ( $170^{\circ}\text{F}$ ) than for the comparable rib or center loin sections. At  $170^{\circ}\text{F}$ , the  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and 1-in. center loin had higher total moisture values than rib chops, with the  $\frac{3}{4}$ -in. center loin significantly higher than rib chops. At  $155^{\circ}\text{F}$ , the 1 or  $1\frac{1}{2}$ -in. rib had slightly higher total moisture than center loin chops.

Table 8. Total moisture (%), total cooking time (min), cooking losses (%) and Gardner color difference meter values of rib, center loin, and/or shoulder broiled chops.<sup>1,2</sup>

Treatments	Total moisture	Total cooking time	Cooking losses	Gardner color difference meter values		
				Rd	a	b
$\frac{1}{4}$ -in. 170°F						
Rib	60.7	9.4	22.0	30.56	+1.22 *	+12.68 *
Center loin	64.3	9.5	20.6	28.05	+3.25	+11.44
Shoulder	----	16.8	28.7	----	----	----
LSD*	----	1.7	3.7	----	----	----
$\frac{3}{8}$ -in. 170°F						
Rib	62.3 *	16.0	24.2	29.94 *	+7.79	+12.77
Center loin	65.5	13.5	23.2	24.95	+0.47	+13.80
Shoulder		22.5	27.0	----	----	----
LSD*	----	6.1	2.7	----	----	----
1-in. 155°F						
Rib	64.4	14.8 **	23.4	31.28 **	+1.03	+21.20 *
Center loin	64.1	18.8	23.0	22.53	+2.23	+11.93
1-in. 170°F						
Rib	62.5	18.4 **	27.5	31.23 **	-1.30 **	+21.46 **
Center loin	63.7	22.9	25.4	21.84	+3.40	+12.96

1½-in. 155°F							
Rib	64.0	24.5	24.3	24.73	+2.17	+13.74	
Center loin	62.3	28.1	24.2	24.85	+1.13	+13.15	
1½-in. 170°F							
Rib	62.4	28.7	26.9	26.77	+0.77	+15.06	
Center loin	62.0	28.5	29.7	22.12	+1.03	+14.10	

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<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Analyses of variance determined for rib, center loin, and shoulder comparisons, "t" tests for all other comparisons.

Total cooking time was longer ( $P < .01$ ) and cooking losses lower for 1-in. center loin than 1-in. rib chops (155 and 170°F). With the 1½-in. center loin chops, as compared to 1½-in. rib chops at 155°F, an increased total cooking time and slightly decreased cooking losses were observed. However with chops broiled to an end point temperature of 170°F, when the 1½-in. center loin had the shorter total cooking time it also had higher cooking losses.

For ¾-in. (170°F,  $P < .05$ ) and 1-in. (170 and 185°F,  $P < .01$ ) chops, reflectance (Rd) was lower for center loin than rib chops. The ¾-in. (170°F,  $P < .05$ ) and 1-in. (170°F,  $P < .01$ ) broiled center loin chops were redder (+a) than the rib. Center loin had lower yellowness values than rib chops at ¾-in. (170°F,  $P < .05$ ) and 1-in. (155 and 170°F,  $P < .01$ ).

With sectional comparison, the ¾ and ¾-in. (170°F) shoulder chops had significantly higher cooking losses than either rib or center loin chops. On the whole, center loin chops had higher total moisture than rib chops. Total cooking time was longer ( $P < .05$ ) and cooking losses higher for 1-in. center loin than comparable rib chops at 155 and 170°F.

Generally, reflectance values were lower for the center loin chops than for the rib chops. Also, a slight trend towards higher redness values and lower yellowness values were indicated for center loin than rib chops.

#### Comparison of Right Versus Left Chops

For rib and center loin chops, a comparison was made of



Table 9. Cooking losses (%), chop weight (g), and total cooking time (min) for right and left rib and center loin chops.<sup>1,2</sup>

Treatments	Cooking losses		Chop weight		Total cooking time	
	Left	Right	Left	Right	Left	Right
Rib						
$\frac{1}{2}$ -in. 170°F	22.0	22.1	86.7	84.9	9.5	9.3
185°F	28.0	30.4	88.2	85.8	13.9	12.8
$\frac{3}{4}$ -in. 170°F	23.3	25.1	131.1	133.7	15.7	16.2
185°F	27.7	28.7	126.8	127.4	18.2	17.2
1-in. 155°F	23.2	23.5	161.4	165.2	14.1	15.4
170°F	27.2	27.8	163.2	166.9	18.3	18.4
185°F	33.3	33.4	160.9	164.5	24.8*	17.1
$1\frac{1}{2}$ -in. 155°F	24.6	24.1	234.0	246.0	23.6	25.4
170°F	28.4	25.4	235.7	247.1	29.6	27.8
185°F	32.5	32.3	236.2	248.2	36.2**	32.2
Center loin						
$\frac{1}{2}$ -in. 170°F	21.5	19.6	102.0	100.5	9.5	9.4
$\frac{3}{4}$ -in. 170°F	24.7	21.7	114.1	130.5	12.5	14.4
1-in. 155°F	24.4	21.6	191.4	180.8	18.3	19.2
170°F	25.3	25.6	190.1	184.7	22.8	23.0

1½-in. 155°F

23.0 25.4

279.4 273.1

27.2 29.0

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<sup>1</sup>"t" tests determined for all groups.

<sup>2</sup>Averages of left and right loins.

those from the left with those from the right side of the animal with respect to cooking losses (%), chop weight (g), and total cooking time. These data are presented in Table 9.

Cooking losses and initial chop weight were similar for right and left chops within a thickness, end point and section group. However total cooking time was less for right ribs broiled to 185°F for both 1-in. ( $P < .05$ ) and 1½-in. ( $P < .01$ ) chops. Of 48 comparisons of right and left chops, only in 2-cases were significant differences noted. Consequently for these measurements chops from the right gave similar results to those from the left side.

#### SUMMARY

The effect of end point temperature, thickness, and section on acceptability of broiled pork chops from right and left loins was investigated. Shoulder (½ and ¾-in., 170°F), center loin (½ and ¾-in., 170°F; 1 and 1½-in., 170 and 185°F), and rib chops (½ and ¾-in., 170 and 185°F; 1 and 1½-in., 155, 170, and 185°F) were cut from 12 paired loins.

Generally, juiciness scores, total moisture, cooking losses, and total cooking times tended to increase with thickness. With ½ to ¾-in. rib chops (185°F) the increase was significant for moisture values. Total cooking time increased with thickness ( $P < .01$ ) for right and left shoulder (170°F) and rib (170 and 185°F) and for right loin chops (170°F). With higher end point temperatures, juiciness scores and total moisture were lower, cooking losses greater and total cooking times longer.

Juiciness of center loin and rib chops of the same thickness decreased with the 1-in. rib chop being less juicy ( $P < .05$ ) at  $185^{\circ}\text{F}$  than at  $155$  or  $170^{\circ}\text{F}$  and the  $1\frac{1}{4}$ -in. center loin chops less juicy ( $P < .05$ ) at  $170$  than at  $155^{\circ}\text{F}$ .

Tenderness, flavor, doneness, and coagulum scores and pH or shear values were not significantly affected by thickness. However, flavor was similar or increased slightly with increasing temperature or thickness. Coagulum scores tended to decrease with increasing temperature, indicating more coagulum present. In general, reflectance values and degree of brownness scores indicated that chops became browner with increasing thickness (center loin and rib chops) and temperature (center loin). Degree of brownness scores for 1-in. rib chops (side 1) were higher ( $P < .05$ ) at  $185$  than  $155$  or  $170^{\circ}\text{F}$ . However, for shoulder chops, degree of brownness decreased ( $P < .05$ ) as thickness increased and as temperature increased for 1-in. center loin ( $P < .01$ ). Increasing temperature from  $155$  to  $170$  to  $185^{\circ}\text{F}$ , chops became browner ( $P < .05$ ) for side 1 of  $1\frac{1}{4}$ -in. rib chops. Uniformity of brownness usually decreased with increased thickness. For rib chops no consistent trends were observed for reflectance or uniformity of brownness with increasing end point temperatures.

Sectional differences were observed with total cooking time and cooking losses significantly higher for  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. shoulder chops ( $170^{\circ}\text{F}$ ) than for comparable rib or center loin chops. On the whole, center loin chops had higher total moisture values than rib chops. Total cooking time was longer

( $P < .01$ ) and cooking losses higher for 1-in. center loin than 1-in. rib chops at 155 and 170°F. Generally, reflectance was lower for the center loin than for the rib chops. Also, a slight trend toward higher redness values and lower yellowness values was indicated for center loin chops. Of 48 comparisons of right and left chops, only in 2-cases were significant differences noted. The 1 ( $P < .05$ ) and 1½-in. ( $P < .01$ ) rib chops broiled to 185°F had significantly longer total cooking times for the left than for right side.

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## APPENDIX

### Explanation of Terms and Abbreviations for Tables

Left refers to left loin  
Right refers to right loin

Side 1 refers to the initial side up on the rack  
Side 2 refers to the initial side down on the rack

Subjective measurements were on a 7 to 1 scale with 7 being optimum

### Gardner Color Difference Meter Values

"Rd" refers to color reflectance  
"+b" refers to yellowness  
"+a" refers to redness

### Significance of data

\* significant at the 5% level of probability  
\*\* significant at the 1% level of probability  
LSD\* least significant difference at the 5% level of probability

D.F. refers to degrees of freedom

Form 1. Score card for pork chops

Judge \_\_\_\_\_ Date \_\_\_\_\_

Sample Number	Tenderness		Juiciness	Flavor	Doneness
	No. chews	Score			
1					
2					
3					
4					
5					
6					

Juiciness

7. Very juicy
6. Juicy
5. Moderately juicy
4. Slightly juicy
3. Moderately dry
2. Very dry
1. Extremely dry

Flavor and Doneness

7. Very desirable
6. Desirable
5. Moderately desirable
4. Slightly desirable
3. Slightly undesirable
2. Moderately undesirable
1. Undesirable

Form 2. Score card for whole pork chops

Judge \_\_\_\_\_

Date \_\_\_\_\_

Sample Number	Brownness			Coagulum	Comments
	Degree	Uniformity			
		1	2		
1					
2					
3					
4					
5					
6					

Degree of Brownness

7. Dark
6. Moderately dark
5. Slightly dark
4. Neutral
3. Slightly light
2. Moderately light
1. Light

Uniformity of Brownness

7. Uniform
6. Moderately uniform
5. Slightly uniform
4. Neutral
3. Slightly uneven
2. Moderately uneven
1. Uneven

Coagulum

7. None
6. —
5. —
4. Moderate amount
3. —
2. —
1. Large amount

Table 10. Objective and subjective data of center loin sections. 1,2

Animal	Color (scores)	Firmness (scores)	Marbling (scores)	Weight of loin (lb)		Muscle area (cm <sup>2</sup> )	
				Left	Right	Left	Right
I	3.0	2.5	2.8	11.6	12.7	21.0	21.2
II	3.0	3.0	2.4	13.1	12.6	26.8	27.6
III	3.0	2.8	3.0	12.6	13.5	28.2	27.0
IV	2.8	2.6	2.5	12.8	12.0	27.8	28.8
V	3.0	3.0	3.1	12.9	12.9	23.5	22.2
VI	3.0	3.0	2.8	13.1	13.2	24.5	----
VII	3.2	3.2	3.1	12.1	12.4	26.6	24.1
VIII	2.8	2.8	2.8	12.5	13.6	30.0	25.7
IX	3.8	2.9	2.2	15.6	14.8	30.6	29.6
X	2.2	1.4	1.9	13.3	14.8	32.2	33.4
XI	3.5	3.0	3.6	12.1	12.7	25.1	24.4
XII	3.3	2.8	2.6	11.0	11.7	25.8	25.6
Av	3.05	2.75	2.73	12.72	13.08	26.8	26.3
S- x	0.11	0.13	0.13	0.32	0.28	00.9	01.0

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Standard error determined for all data.

Table 11. Gardner color difference meter values for left versus right rib and center loin uncooked chops.<sup>1,2,3</sup>

	Center loin		Rib	
	Left	Right	Left	Right
Rd	18.55	18.32	19.19	19.08
+a	9.63	9.74	10.31	9.95
+b	11.01	10.52	12.86	12.59

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Averages of means of data for each section for each animal.

<sup>3</sup>"t" tests determined for all groups.

Table 12. Gardner color difference meter values for left versus right uncooked center loin chops.<sup>1,2</sup>

	Rd	+a	+b
Left loin			
	18.90	9.50	14.65
	15.40	10.48	9.66
	17.22	11.58	10.55
	22.56	7.18	10.48
	19.36	8.82	15.22
	16.45	10.82	9.74
	19.38	8.81	8.77
	18.66	9.84	9.04
Av	18.55	9.63	11.01
Right loin			
	18.34	10.61	10.20
	17.51	10.62	9.70
	17.14	10.45	10.40
	21.86	7.02	12.76
	17.76	10.56	12.75
	16.86	9.41	10.41
	20.48	7.89	8.72
	16.64	11.35	9.19
Av	18.32	9.74	10.52

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.<sup>2</sup>Averages of means of data for each section for each animal.



Table 13. Gardner color difference meter values for left versus right uncooked rib chops.<sup>1,2</sup>

	Rd	+a	+b
Left loin			
	21.75	8.99	10.38
	13.67	9.96	8.30
	21.14	8.15	9.71
	19.12	11.87	16.45
	21.57	11.60	12.82
	15.71	11.09	9.03
	19.44	8.94	10.25
	20.32	12.65	16.62
	20.00	9.53	22.18
Av	19.19	10.31	12.86
Right loin			
	20.03	9.22	11.56
	16.09	10.00	9.65
	20.91	7.46	12.07
	18.72	12.03	17.45
	21.22	9.30	10.37
	16.25	9.91	7.94
	19.07	8.93	8.66
	19.54	12.42	13.43
	19.89	10.28	22.18
Av	19.08	9.95	12.59

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Averages of means of data for each section for each animal.

Table 14. Total cooking time (min) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops broiled to 170°F.

	Right loin		Left loin	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	8.5	15.0	8.0	14.0
	8.5	15.0	7.5	13.0
	8.0	8.0	9.0	9.0
	9.5	14.5	10.5	13.0
	12.5	16.5	10.5	15.0
	9.5	17.5	11.5	11.0
AV	9.4	14.4	9.5	12.5

Table 15. Cooking time (min/lb) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops broiled to 170°P.

	Right loin		Left loin	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	46.8	27.9	47.5	51.9
	40.0	27.8	38.9	45.6
	24.8	37.6	27.9	45.4
	50.2	33.6	53.9	46.1
	68.4	41.9	60.3	58.2
	39.8	29.7	39.0	51.2
AV	45.0	33.1	44.6	49.7

Table 16. Cooking losses (%) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops broiled to 170°F.

	Right loin		Left loin	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	20.0	22.4	20.3	27.8
	17.1	23.0	17.7	25.5
	17.1	19.7	19.5	20.6
	19.2	18.7	25.4	21.9
	24.7	22.1	25.3	23.5
	19.4	24.1	20.9	28.7
AV	19.6	21.7	21.5	24.7

Table 17. Juiciness and flavor (scores) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops broiled to 170°F.

	Juiciness		Flavor	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	5.5	6.4	5.0	5.6
	5.6	6.2	5.6	5.4
	6.4	6.4	5.4	5.8
	5.4	6.4	4.8	5.2
	5.6	5.6	5.6	5.6
	6.2	5.8	5.4	5.2
AV	5.8	6.1	5.3	5.5

Table 18. Total moisture (%) and pH of  $\frac{1}{2}$  and  $\frac{3}{8}$ -in. center loin chops broiled to 170°F

	Total moisture		pH	
	$\frac{1}{2}$ -in.	$\frac{3}{8}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{8}$ -in.
	63.4	65.0	5.90	5.99
	64.8	66.4	5.90	6.00
	67.5	65.0	5.92	5.90
	64.2	68.8	5.90	5.90
	62.8	64.2	5.92	5.87
	63.0	63.4	5.90	-----
AV	64.3	65.5	5.91	5.93

Table 19. Tenderness of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops broiled to 170°F.

	No. chews		Scores	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	18.5	23.2	6.2	6.2
	21.8	24.6	6.6	5.8
	24.4	24.6	6.0	6.0
	22.6	26.6	6.2	5.6
	24.0	23.8	5.8	5.6
	27.6	25.4	5.4	5.4
AV	23.2	25.1	6.0	5.8

Table 20. Doneness and coagulum (scores) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops broiled to 170°F.

	Doneness		Coagulum	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	5.5	5.8	4.8	3.8
	5.8	5.8	6.2	3.6
	5.0	5.2	6.6	5.4
	5.4	5.4	2.7	4.0
	5.8	4.6	4.7	3.3
	5.4	5.4	3.0	3.7
AV	5.5	5.4	4.7	4.0



Table 21. Degree of brownness (scores) of  $\frac{1}{2}$  and  $\frac{3}{8}$ -in. center loin chops broiled to 170°F.

	Side 1		Side 2	
	$\frac{1}{2}$ -in.	$\frac{3}{8}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{8}$ -in.
	4.8	4.6	6.0	5.4
	3.8	5.0	4.6	4.8
	4.2	4.6	3.0	4.4
	1.7	3.0	2.7	2.3
	1.7	3.0	3.3	3.0
	4.7	5.0	3.0	3.3
AV	3.5	4.2	3.8	3.9

Table 22. Uniformity of brownness (scores) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops broiled to 170°F.

	Side 1		Side 2	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	5.2	5.0	2.6	3.6
	5.6	4.6	4.2	4.2
	5.8	4.8	6.6	4.6
	6.0	5.0	6.0	5.7
	6.0	4.0	5.7	5.7
	5.0	5.7	5.7	6.0
AV	5.6	4.8	5.1	5.0

Table 23. Gardner color difference meter values of right raw  $\frac{1}{2}$ -in. and  $\frac{3}{4}$ -in. center loin chops.<sup>1</sup>

	Rd		+a		+b	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	15.92	16.45	12.78	12.70	9.35	9.62
	19.25	15.15	10.32	11.88	9.38	9.95
	16.80	16.25	10.30	10.10	8.65	8.20
	17.90	21.15	8.80	8.60	8.60	8.85
	21.70	19.60	8.30	7.65	9.10	8.55
	20.55	21.95	7.15	6.05	8.50	8.70
Av	18.69	18.42	9.61	9.63	8.90	9.00

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 24. Gardner color difference meter values of left raw  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops.<sup>1</sup>

	Rd		+a		+b	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	19.25	18.07	9.88	11.32	8.80	9.55
	18.72	18.75	10.55	9.95	9.10	9.30
	19.00	18.20	9.10	8.25	9.00	8.50
	17.75	20.20	10.25	8.00	8.58	8.70
	21.00	20.48	8.70	8.40	9.00	9.00
	16.50	23.05	11.10	6.40	8.75	8.60
AV	18.70	19.79	9.93	8.72	8.90	8.90

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 25. Gardner color difference meter values of side 1 of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops broiled to 170°F.<sup>1</sup>

	Rd		+a		+b	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	27.40	21.10	1.30	3.40	12.15	12.10
	23.85	20.25	5.45	5.55	10.50	13.12
	20.18	28.48	5.58	2.45	11.38	13.82
	31.90	26.40	0.70	4.95	11.15	11.90
	27.50	26.60	1.58	2.60	12.90	11.70
	19.50	13.52	6.60	6.05	12.20	10.55
Av	25.06	22.72	3.54	4.17	11.71	12.20

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 26. Gardner color difference meter values of side 2 of  $\frac{1}{2}$ -in. and  $\frac{3}{8}$ -in. center loin chops broiled to 170°F.<sup>1</sup>

	Rd		a		+b	
	$\frac{1}{2}$ -in.	$\frac{3}{8}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{8}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{8}$ -in.
	32.30	22.40	+9.70	-2.20	10.35	10.75
	-----	23.25	-----	+1.10	-----	10.90
	29.50	26.85	+5.90	+2.75	11.90	13.20
	35.60	34.90	-0.60	-4.30	10.30	13.25
	30.00	29.35	+1.20	-0.90	12.80	12.50
	30.80	26.30	-1.64	0.00	10.20	19.50
Av	31.64	27.18	+2.91	-0.59	11.10	13.40

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 27. Chop weights (g) for  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. center loin chops.

	Right loin		Left loin	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	82.5	138.5	76.5	122.5
	96.5	139.0	87.5	129.5
	146.5	96.5	146.5	90.0
	86.0	128.5	88.5	128.0
	83.0	135.5	79.0	117.0
	108.5	145.0	134.0	97.5
AV	100.5	130.5	102.0	114.1

Table 28. Total cooking time (min) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. shoulder chops broiled to 170°F.

	Right loin		Left loin	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	15.0	26.0	16.0	20.5
	19.5	23.5	16.0	20.5
	18.0	23.0	14.5	19.5
	15.5	25.5	18.0	21.5
	16.5	25.0	15.5	21.5
	20.5	22.5	16.5	21.5
AV	17.5	24.2	16.1	20.7



Table 29. Cooking time (min/lb) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. shoulder chops broiled to 170°F.

	Right loin		Left loin	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	48.0	48.6	53.0	40.8
	54.6	44.2	46.2	40.5
	52.7	45.8	48.9	40.7
	46.8	47.4	58.8	41.2
	43.6	49.2	43.4	42.4
	62.2	49.5	49.8	50.3
AV	51.3	47.4	50.0	42.6

Table 30. Cooking losses (%) of  $\frac{3}{4}$ -in. and  $\frac{1}{2}$ -in. shoulder chops broiled to 170°F.

	Right loin		Left loin	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	25.7	27.8	23.4	21.7
	26.5	27.3	23.6	26.7
	34.8	28.9	31.2	25.2
	27.9	28.5	29.1	22.8
	32.0	30.8	24.7	25.2
	34.1	30.8	31.6	28.9
AV	30.2	29.0	27.3	25.1

Table 31. Doneness, juiciness, and flavor (scores) of  $\frac{3}{4}$  and  $\frac{5}{8}$ -in. shoulder chops broiled to 170°F.

	Doneness		Juiciness		Flavor	
	$\frac{3}{4}$ -in.	$\frac{5}{8}$ -in.	$\frac{3}{4}$ -in.	$\frac{5}{8}$ -in.	$\frac{3}{4}$ -in.	$\frac{5}{8}$ -in.
	5.5	6.0	4.8	5.7	5.8	5.0
	4.5	5.5	4.0	5.2	5.2	6.2
	5.8	6.0	4.5	4.2	5.5	5.5
	6.0	5.5	5.0	5.5	6.0	5.2
	6.0	5.0	5.5	5.8	5.0	4.2
	5.8	5.5	5.0	5.8	4.5	5.0
Av	5.6	5.6	4.8	5.4	5.3	5.2

Table 32. Tenderness and coagulum (scores) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. shoulder chops broiled to 170°F.

	Tenderness no. chews		Tenderness score		Coagulum	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	25.5	22.3	5.8	6.3	6.8	6.0
	29.2	26.5	5.0	5.5	6.8	6.8
	29.8	27.8	5.5	5.8	6.0	6.0
	24.5	25.0	6.2	6.0	6.4	4.0
	25.2	21.8	6.0	6.5	6.0	4.6
	24.5	21.2	6.0	6.2	5.8	4.8
AV	26.4	24.1	5.8	6.0	6.3	5.4

Table 33. Degree of brownness (scores) of  $\frac{1}{2}$  and  $\frac{3}{8}$ -in. shoulder chops broiled to 170°F.

	Side 1		Side 2	
	$\frac{1}{2}$ -in.	$\frac{3}{8}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{8}$ -in.
	6.2	6.2	4.8	5.2
	6.2	5.5	4.8	5.5
	4.8	4.8	5.0	4.5
	4.2	4.0	5.6	5.8
	4.2	4.4	5.0	5.6
	3.6	3.4	5.4	5.0
AV	4.9	4.7	5.1	5.3

Table 34. Uniformity of brownness (scores) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. shoulder chops broiled to 170°F.

	Side 1		Side 2	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	5.5	4.5	5.8	4.8
	5.2	5.2	5.2	4.0
	4.2	4.0	4.8	4.8
	6.0	4.6	4.8	3.4
	6.0	5.2	5.4	3.4
	5.4	5.0	3.6	3.6
AV	5.4	4.8	4.9	4.0

Table 35. Chop weight (g) for  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. shoulder chops.

	Right loin		Left loin	
	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.	$\frac{1}{2}$ -in.	$\frac{3}{4}$ -in.
	142.0	243.0	137.0	228.0
	162.0	241.5	157.0	230.0
	155.0	228.0	134.5	206.5
	150.5	244.0	139.0	237.0
	172.0	230.5	162.0	230.0
	149.5	206.5	150.5	194.0
AV	155.2	232.4	146.7	221.4

Table 36. Total cooking time (min) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
Right loin				
	10.5	11.5	17.5	19.0
	7.5	13.0	18.0	15.5
	15.0	14.5	17.0	19.0
	6.5	11.5	13.0	15.5
	8.5	14.0	16.0	18.0
	8.0	12.5	16.0	16.0
Av	9.3	12.8	16.2	17.2
Left loin				
	9.0	13.0	18.0	20.5
	9.0	12.5	14.0	17.5
	13.5	19.0	14.0	19.5
	7.0	13.0	15.5	18.0
	9.5	13.5	16.5	17.0
	9.5	12.5	16.0	17.0
Av	9.6	13.9	15.7	18.2



Table 37. Cooking time (min/lb) of  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
<b>Right loin</b>				
	49.4	51.7	57.0	61.8
	35.5	62.4	57.8	51.7
	99.4	77.2	55.9	74.4
	36.9	62.2	44.9	55.4
	47.6	76.6	56.8	68.1
	41.5	74.2	58.8	57.6
<b>Av</b>	51.7	67.4	55.2	61.5
<b>Left loin</b>				
	45.6	63.8	60.8	67.7
	45.6	59.7	46.4	59.7
	73.8	96.4	49.6	76.0
	37.6	68.6	53.5	64.3
	50.4	75.2	57.0	61.5
	49.0	67.2	58.6	63.5
<b>Av</b>	50.3	71.8	54.3	65.4

Table 38. Cooking losses (%) of  $\frac{1}{2}$  and  $\frac{3}{8}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{8}$ -in.	
	170°F	185°F	170°F	185°F
Right loin				
	21.2	22.3	25.4	29.0
	15.6	30.2	23.0	29.0
	19.7	39.7	26.1	28.0
	23.1	31.5	26.6	28.0
	23.4	28.9	25.0	28.3
	29.7	30.1	24.3	29.8
Av	22.1	30.4	25.1	28.7
Left loin				
	13.4	21.6	22.3	25.4
	15.1	20.0	17.5	20.7
	30.7	36.3	17.6	30.5
	25.4	28.5	28.1	30.7
	25.1	36.2	28.9	31.1
	22.2	25.4	25.4	27.6
Av	22.0	28.0	23.3	27.7

Table 39. Juiciness and flavor (scores) of broiled  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
<b>Juiciness</b>				
	4.4	4.6	4.8	4.8
	5.2	4.0	5.2	4.8
	5.4	3.4	5.0	5.6
	5.6	5.6	5.2	4.8
	4.8	5.0	5.2	4.4
	5.2	5.0	6.0	5.6
<b>Av</b>	5.1	4.6	5.2	5.0
<b>Flavor</b>				
	5.4	5.6	5.8	6.2
	5.8	4.8	5.2	4.6
	5.8	6.0	5.4	5.2
	5.6	6.0	5.6	5.0
	5.6	5.8	5.6	6.0
	5.0	4.2	5.8	6.0
<b>Av</b>	5.5	5.4	5.7	5.5

Table 40. Total moisture (%) and pH of broiled  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
Total moisture				
	62.7	60.7	61.6	62.4
	66.2	57.6	65.6	59.8
	64.8	47.5	64.3	61.4
	61.7	55.6	61.8	61.1
	55.4	54.0	58.0	57.0
	53.4	57.0	62.7	60.4
Av	60.7	55.4	62.3	60.4
pH				
	6.02	6.10	6.03	6.10
	6.10	6.11	6.11	6.10
	6.08	6.13	6.08	6.18
	6.01	6.09	6.10	6.14
	5.96	5.97	5.98	5.97
	5.91	5.92	5.92	5.94
Av	6.01	6.05	6.04	6.07

Table 41. Tenderness of broiled  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
<b>No. chews</b>				
	20.8	24.6	24.0	24.6
	22.6	23.2	23.0	23.8
	21.6	22.2	23.6	24.8
	22.4	22.6	25.4	24.2
	23.8	21.6	24.6	25.8
	22.2	22.4	24.6	22.8
<b>Av</b>	22.2	22.8	24.2	24.3
<b>Scores</b>				
	6.2	5.8	6.0	5.8
	6.4	6.0	6.4	6.0
	6.2	6.2	6.2	5.8
	6.4	6.2	5.8	6.0
	6.0	6.2	5.8	5.6
	6.4	6.2	6.0	6.2
<b>Av</b>	6.3	6.1	6.0	5.9

Table 42. Doneness and coagulum (scores) of broiled  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
Doneness				
	5.2	5.0	5.4	5.4
	5.8	5.2	5.8	5.4
	5.4	4.6	5.2	5.6
	6.0	5.8	5.6	5.4
	5.4	5.4	5.6	5.4
	6.0	5.6	5.6	5.8
Av	5.6	5.3	5.5	5.5
Coagulum				
	4.6	4.2	5.0	6.2
	4.8	6.2	6.0	6.4
	6.0	6.0	4.8	4.6
	5.2	5.2	6.0	5.6
	3.6	4.4	4.6	4.0
	3.4	4.8	5.4	4.6
Av	4.6	5.1	5.3	5.2

Table 43. Degree of brownness (scores) of broiled  $\frac{1}{2}$ -in. and  $\frac{3}{4}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
Side 1				
	2.4	2.2	2.6	2.4
	2.0	2.0	2.6	2.4
	2.4	2.2	1.6	2.4
	2.6	2.0	3.0	2.6
	4.0	4.0	4.4	4.4
	2.4	2.4	3.4	3.4
Av	2.6	2.5	2.9	2.9
Side 2				
	1.8	2.4	2.6	3.4
	1.8	2.4	2.6	2.8
	3.2	4.2	2.2	3.2
	1.8	2.8	3.4	3.6
	2.4	4.8	5.4	4.8
	2.8	4.4	4.8	4.8
Av	2.3	3.5	3.5	3.8

Table 44. Uniformity of brownness (scores) of broiled  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
Side 1				
	6.6	6.2	5.8	5.8
	6.0	6.2	5.6	5.8
	6.8	7.0	6.4	6.8
	5.2	6.0	5.4	5.8
	5.6	6.2	5.8	5.8
	5.8	5.6	5.6	5.4
Av	6.0	6.2	5.8	5.9
Side 2				
	6.2	5.4	4.2	4.6
	6.4	5.8	6.0	5.4
	4.8	3.8	6.4	3.8
	6.2	5.6	5.0	4.4
	5.0	2.8	4.2	3.0
	5.2	3.2	4.8	4.2
Av	5.6	4.4	5.1	4.2



Table 45. Gardner color difference meter values of right raw  $\frac{1}{2}$ -in. and  $\frac{3}{8}$ -in. rib chops.<sup>1</sup>

	$\frac{1}{2}$ -in.		$\frac{3}{8}$ -in.	
	170°F	185°F	170°F	185°F
Rd	16.72	18.35	16.15	17.05
	16.40	13.90	15.50	14.65
	21.75	20.88	20.45	22.35
	21.10	22.40	18.70	19.65
	20.40	22.20	20.30	21.40
	19.20	16.35	20.80	19.60
Av	19.26	19.01	18.65	19.12
+a	10.92	9.50	8.45	10.60
	9.20	12.60	9.95	9.30
	6.95	6.85	8.80	7.35
	7.20	7.90	7.45	7.20
	8.50	7.40	6.70	7.05
	11.75	11.50	9.85	11.05
Av	9.09	9.29	8.53	8.76
+b	9.92	9.95	7.92	9.65
	10.00	9.65	10.30	9.80
	8.00	8.80	9.50	10.00
	19.90	19.90	10.25	10.18
	10.65	10.20	10.60	10.10
	19.70	10.20	10.10	10.90
Av	13.00	11.40	9.80	10.10

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 46. Gardner color difference meter values of left raw  $\frac{1}{8}$  and  $\frac{3}{8}$ -in. rib chops.<sup>1</sup>

	$\frac{1}{8}$ -in.		$\frac{3}{8}$ -in.	
	170°F	185°F	170°F	185°F
Rd	14.78	14.45	9.75	13.00
	16.65	13.15	14.45	13.10
	16.00	16.25	20.80	22.30
	21.70	23.35	23.60	23.15
	22.30	23.50	23.80	20.40
	21.00	22.00	20.00	21.00
Av	18.74	19.12	18.73	18.82
+a	10.20	11.18	12.25	12.45
	9.80	8.75	7.70	7.35
	10.65	9.30	7.90	9.30
	8.25	7.70	5.90	6.20
	8.30	8.30	6.85	8.00
	9.50	9.10	11.25	10.65
Av	9.45	9.06	8.64	8.99
+b	9.95	9.70	9.50	9.65
	9.50	6.15	6.15	5.80
	8.20	9.10	8.90	10.10
	10.45	10.40	10.15	10.40
	10.80	10.25	10.35	10.40
	10.20	10.70	10.20	10.10
Av	9.80	9.40	9.20	9.40

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 47. Gardner color difference meter values of side 1 of broiled  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.<sup>1</sup>

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
Hd	28.18	30.32	24.58	27.85
	27.62	29.20	27.70	28.65
	26.50	26.75	27.90	22.35
	28.70	28.48	27.15	28.00
	26.15	26.80	30.20	30.60
	31.72	33.82	29.40	29.80
Av	28.14	29.23	27.82	27.88
a	+1.48	-0.52	+3.12	+2.75
	+4.68	+3.45	+4.75	+0.90
	+2.40	+1.00	+4.55	+2.90
	-0.35	-0.85	-1.10	+2.00
	+2.45	+3.10	+0.95	+1.80
	----	----	+2.05	----
Av	+2.33	+1.24	+2.39	+2.07
+b	13.28	14.55	13.40	14.55
	13.50	14.25	14.72	14.95
	14.70	14.80	13.90	15.80
	14.08	12.92	14.55	14.15
	12.30	13.00	12.15	12.40
	12.52	10.85	10.10	11.00
	Av	13.40	13.40	13.14

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 48. Gardner color difference meter values of side 2 of broiled  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.<sup>1</sup>

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
Rd	33.30	35.30	32.60	36.40
	34.45	35.20	33.70	36.90
	32.00	24.95	29.15	20.00
	29.96	26.50	26.60	25.92
	29.75	31.60	35.30	35.00
	38.35	29.35	35.00	34.80
Av	32.97	30.48	32.06	31.50
a	+0.45	-3.55	-1.60	-2.30
	+0.50	-3.40	-2.40	-3.10
	+0.50	-1.10	-2.20	+1.30
	-0.42	+1.15	-0.25	+2.75
	-0.50	-1.50	-3.05	-2.45
	----	----	----	----
Av	+0.11	-1.68	-1.90	-0.76
+b	12.70	11.90	13.20	14.30
	13.30	11.90	13.30	14.50
	10.85	12.05	13.85	15.65
	10.70	13.50	13.55	13.75
	13.20	11.40	12.45	12.20
	11.00	11.45	11.20	12.40
Av	11.96	12.03	12.92	13.80

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 49. Chops weights (g) of broiled  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. rib chops.

	$\frac{1}{2}$ -in.		$\frac{3}{4}$ -in.	
	170°F	185°F	170°F	185°F
Left loin				
	89.5	92.5	134.5	137.5
	89.5	95.0	137.0	133.0
	83.0	89.5	128.0	116.5
	84.5	86.0	131.5	127.0
	85.5	81.5	131.5	125.5
	88.0	84.5	124.0	121.5
Av	86.7	88.2	131.1	126.8
Right loin				
	96.5	101.0	139.5	139.5
	96.0	94.5	141.5	136.0
	68.5	75.5	138.0	116.0
	80.0	84.0	131.5	127.0
	81.0	83.0	128.0	120.0
	87.5	76.5	123.5	126.0
Av	84.9	85.8	133.7	127.4

Table 50. Total cooking time (min) of broiled 1-in. center loin chops.

	Right loin		Left loin	
	155°F	170°F	155°F	170°F
	22.0	28.0	18.0	-----
	22.0	24.0	16.0	23.0
	21.0	27.0	18.0	23.0
	20.0	19.0	22.0	24.0
	14.0	20.0	19.0	21.0
	16.0	20.0	17.0	23.0
Av	19.2	23.0	18.3	22.8

Table 51. Cooking time (min/lb) of broiled 1-in. center loin chops.

	Right loin		Left loin	
	155°F	170°F	155°F	170°F
	56.0	72.2	50.4	-----
	56.1	56.6	37.1	62.5
	56.1	69.1	40.0	58.8
	48.0	45.2	50.3	54.8
	32.0	44.5	39.7	43.9
	42.5	54.4	45.4	55.0
AV	48.4	57.0	43.8	55.0

Table 52. Cooking losses (%) of broiled 1-in. center loin chops.

	Right loin		Left loin	
	155°F	170°F	155°F	170°F
	23.5	30.4	24.1	28.4
	23.9	23.1	17.1	13.8
	21.5	28.7	35.4	30.1
	22.2	23.0	25.4	25.1
	19.1	27.2	20.9	25.3
	19.6	21.2	23.8	28.9
AV	21.6	25.6	24.4	25.3



Table 53. Doneness, juiciness, and flavor (scores) of broiled 1-in. center loin chops.

	Doneness		Juiciness		Flavor	
	155°F	170°F	155°F	170°F	155°F	170°F
	6.0	5.6	5.8	5.2	6.0	5.4
	5.4	5.2	5.6	5.8	5.2	5.4
	5.8	5.6	6.0	5.0	5.6	6.2
	5.2	5.2	6.5	6.2	6.0	6.0
	4.5	6.0	6.2	5.5	5.2	6.5
	5.2	4.8	5.8	6.2	5.8	5.0
Av	5.4	5.4	6.0	5.6	5.6	5.8

Table 54. Total moisture (%), pH, and shear values of ( $\frac{1}{4}$ -in. cores) of broiled 1-in. center loin chops.

	Total moisture		pH		Shear values	
	155°F	170°F	155°F	170°F	155°F	170°F
	64.8	63.5	6.12	6.18	7.9	7.4
	67.8	65.6	6.19	6.30	6.5	4.0
	64.8	65.6	5.80	5.82	8.5	5.0
	60.2	59.8	5.80	5.81	9.1	8.2
	62.8	61.1	5.80	5.83	9.4	9.0
	64.4	66.5	6.10	6.12	5.9	7.2
AV	64.1	63.7	5.97	6.01	7.9	6.8

Table 55. Tenderness and coagulum (scores) of broiled 1-in. center loin chops.

	Tenderness		Tenderness		Coagulum	
	no. chops		score			
	155°F	170°F	155°F	170°F	155°F	170°F
	20.8	21.0	6.6	6.4	5.8	5.4
	22.4	18.8	6.2	6.4	6.4	3.2
	19.8	21.8	6.6	6.2	4.8	4.2
	22.2	27.2	6.8	5.8	3.0	3.5
	20.8	21.2	6.8	5.5	3.5	3.2
	21.8	18.2	6.0	6.5	3.0	3.8
Av	21.3	21.4	6.5	6.1	4.4	3.9

Table 56. Degree of brownness (scores) of broiled 1-in. center loin chops.

	Side 1		Side 2	
	155°F	170°F	155°F	170°F
	3.4	3.6	3.0	3.8
	3.8	4.0	2.6	5.0
	3.8	4.2	3.4	6.6
	4.0	4.2	1.8	3.0
	4.5	4.8	1.5	3.8
	4.5	4.8	2.2	1.8
AV	4.0	4.3	2.4	4.0

Table 57. Uniformity of brownness (scores) of broiled 1-in. center loin chops.

	Side 1		Side 2	
	155°F	170°F	155°F	170°F
	4.6	6.4	6.2	5.4
	4.4	6.4	5.6	4.6
	4.2	5.2	5.6	3.8
	5.2	5.2	6.2	5.5
	4.2	5.5	6.2	5.5
	3.5	4.5	5.8	6.0
AV	4.4	5.5	5.9	5.1

Table 58. Gardner color difference meter values of right raw 1-in. center loin chops.<sup>1</sup>

	Rd		+a		+b	
	155°F	170°F	155°F	170°F	155°F	170°F
	17.25	18.15	11.55	9.80	10.10	9.70
17.50	17.15	11.10	10.05	9.90	9.10	
17.50	18.20	10.20	10.30	9.60	10.15	
17.25	15.80	8.85	10.50	9.60	10.40	
16.50	17.90	10.10	8.20	12.00	9.65	
16.95	15.90	12.10	9.20	11.15	9.25	
Av	17.16	17.18	10.65	9.68	10.39	9.70

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 59. Gardner color difference meter values of left raw 1-in. center  
1cin chops.<sup>1</sup>

	Rd		+a		+b	
	155°F	170°F	155°F	170°F	155°F	170°F
	16.10	16.10	10.90	9.50	9.90	9.50
	15.10	14.30	10.90	10.60	9.75	9.50
	15.40	19.20	12.30	11.80	10.55	10.60
	15.45	15.55	10.50	10.95	9.60	9.70
	17.40	17.40	11.15	10.70	9.35	10.05
	16.40	17.90	11.20	11.00	10.55	10.50
AV	15.98	16.74	11.16	10.76	10.00	10.00

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 60. Gardner color difference meter values of side 1 of broiled 1-in. center loin chops.<sup>1</sup>

	Rd		+a		+b	
	155°F	170°F	155°F	170°F	155°F	170°F
	18.75	24.90	5.40	9.70	13.20	11.90
	19.50	13.55	4.10	3.55	12.80	12.45
	17.40	17.80	9.00	5.90	13.80	16.00
	23.58	25.85	1.65	1.88	9.82	12.00
	27.85	20.60	0.95	3.15	10.20	14.60
	23.85	27.15	1.25	0.52	10.48	12.70
Av	21.82	21.64	3.72	4.12	11.70	13.28

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.



Table 61. Gardner color difference meter values of side 2 of broiled 1-in. center loin chops.<sup>1</sup>

	Rd		a		+b	
	155°F	170°F	155°F	170°F	155°F	170°F
	24.80	24.80	+2.00	+9.75	11.15	12.40
	25.40	14.30	-0.35	+2.20	11.70	12.65
	20.50	32.00	+0.45	-1.15	12.10	12.05
	20.00	23.55	+1.55	+1.22	12.45	12.92
	24.35	13.20	+2.70	+2.78	13.65	14.20
	24.48	24.48	+1.25	+1.30	11.82	11.70
Av	23.26	22.06	+1.27	+2.68	12.10	12.65

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 62. Chop weights (g) for 1-in. center loin chops.

	Right loin		Left loin	
	155°F	170°F	155°F	170°F
	178.5	176.0	162.0	190.0
	178.0	192.5	196.0	167.0
	170.0	177.5	204.5	177.5
	189.0	191.0	198.5	199.0
	198.5	204.0	217.5	217.0
	171.0	167.0	170.0	190.0
Av	180.8	184.7	191.4	190.1

Table 63. Total cooking time (min) of 1-in. rib chops.

	155°F	170°F	185°F
Right loin			
	43.2	42.6	30.5
	39.3	44.7	38.3
	39.3	53.9	54.7
	42.7	52.4	33.1
	46.8	62.7	79.3
	43.8	43.8	48.8
Av	42.5	50.0	64.1
Left loin			
	----	----	----
	47.0	45.5	82.1
	31.7	57.5	53.1
	40.8	38.2	----
	49.6	61.3	88.5
	42.4	54.0	55.1
Av	42.3	51.3	69.7

Table 64. Cooking time (min/lb) of 1-in. rib chops.

	155°F	170°F	185°F
Right loin			
	15.0	15.5	11.0
	13.5	15.5	13.5
	17.0	22.5	23.5
	16.0	21.0	12.0
	15.5	21.0	25.5
	15.5	15.0	17.0
Av	15.4	18.4	17.1
Left loin			
	10.0	----	26.5
	16.0	16.5	30.1
	12.5	24.0	22.0
	16.0	15.0	----
	16.5	18.5	27.0
	13.5	17.5	18.5
Av	14.1	18.3	24.8

Table 65. Cooking losses (%) of 1-in. rib chops from right and left loin.

	155°F	170°F	185°F
Right loin			
	25.7	26.1	43.4
	28.2	34.9	41.4
	20.8	23.2	23.4
	22.1	22.8	25.3
	22.4	30.9	35.6
	22.0	28.8	31.6
Av	23.5	27.8	33.4
Left loin			
	----	----	----
	29.5	29.6	40.4
	24.9	26.4	41.1
	21.1	27.2	25.9
	17.3	32.4	20.2
	23.3	20.2	38.7
Av	23.2	27.2	33.3

Table 66. Juiciness and flavor (scores) of broiled 1-in. rib chops.

	155°F	170°F	185°F
<b>Juiciness</b>			
	5.8	6.0	4.4
	6.2	5.6	5.0
	5.6	4.8	4.6
	5.4	5.8	5.4
	5.2	5.6	5.2
	6.2	5.4	5.4
<b>Av</b>	5.7	5.5	5.0
<b>Flavor</b>			
	5.6	5.4	5.2
	5.2	5.2	6.0
	5.4	5.4	5.2
	5.2	5.8	6.0
	5.6	5.6	6.2
	5.8	5.6	5.6
<b>Av</b>	5.5	5.5	5.7

Table 67. Total moisture (%) and pH of broiled 1-in. rib chops.

	155°F	170°F	185°F
Total moisture			
	62.0	61.5	54.8
	65.4	62.2	65.1
	61.6	62.9	59.2
	65.5	63.9	60.0
	64.9	62.7	60.2
	66.2	61.8	59.6
Av	64.3	62.5	59.8
pH			
	5.85	5.85	5.84
	5.88	5.88	5.85
	5.75	5.75	5.72
	5.82	5.84	5.85
	5.91	5.87	5.95
	5.88	5.94	6.00
Av	5.85	5.86	5.87

Table 68. Shear values ( $\frac{1}{8}$ -in. cores) of broiled 1-in. rib chops.

	155°F	170°F	185°F
	5.5	6.2	5.2
	6.2	7.2	9.6
	5.3	7.6	7.6
	4.2	6.4	4.8
	7.0	5.3	10.7
	9.0	12.6	7.6
Av	6.2	7.6	7.6



Table 69. Tenderness of broiled 1-in. rib chops.

	155°F	170°F	185°F
<b>No. chews</b>			
	18.2	20.4	24.6
	22.8	22.4	25.2
	18.8	21.0	20.6
	22.6	23.6	24.0
	24.2	24.6	22.6
	24.4	24.6	22.0
<b>Av</b>	21.8	22.8	23.2
<b>Scores</b>			
	6.4	6.2	6.0
	6.0	6.2	5.6
	6.6	6.2	6.4
	6.2	6.2	5.8
	5.8	6.0	6.2
	6.2	6.6	6.6
<b>Av</b>	6.2	6.2	6.1

Table 70. Doneness and coagulum (scores) of broiled 1-in. rib chops.

	155°F	170°F	185°F
<b>Doneness</b>			
	5.6	5.6	6.2
	5.8	5.6	5.6
	5.6	5.8	5.8
	5.8	5.6	6.0
	5.4	6.0	6.4
	5.8	5.4	5.6
<b>Av</b>	5.7	5.7	5.9
<b>Coagulum</b>			
	5.4	3.8	4.6
	5.8	5.2	4.4
	5.6	4.6	4.8
	5.8	5.0	5.0
	5.0	4.0	3.4
	6.2	3.4	1.0
<b>Av</b>	5.6	4.3	3.9

Table 71. Degree of brownness (scores) of broiled 1-in. rib chops.

	155°F	170°F	185°F
Side 1			
	4.2	4.2	6.6
	4.4	4.4	5.6
	3.4	4.0	5.8
	2.4	5.2	4.4
	4.6	4.2	5.2
	3.6	4.0	5.0
Av	3.8	4.3	5.4
Side 2			
	4.4	4.8	6.2
	4.8	4.2	6.8
	4.2	4.0	5.8
	2.0	5.0	5.4
	5.6	4.4	5.2
	4.4	3.8	3.4
Av	4.2	4.4	5.5

Table 72. Uniformity of brownness (scores) of broiled 1-in. rib chops.

	155°F	170°F	185°F
Side 1			
	5.4	5.6	3.8
	4.8	4.8	3.2
	4.8	4.8	4.6
	5.4	3.4	3.8
	4.0	5.4	4.2
	4.6	4.0	3.6
Av	4.8	4.7	3.9
Side 2			
	5.0	4.6	4.0
	4.0	4.8	3.6
	5.6	5.6	4.4
	5.6	4.0	4.4
	4.0	5.2	3.0
	5.0	3.0	3.0
Av	4.9	4.5	3.7

Table 73. Gardner color difference meter values of left raw 1-in. rib chops.<sup>1</sup>

	155°F	170°F	185°F
Rd	21.50	21.50	19.50
	19.80	20.25	19.38
	19.55	20.60	21.20
	19.50	20.22	18.90
	17.85	20.01	21.50
	16.98	19.78	18.60
Av	19.20	20.39	19.85
+a	12.0	9.8	15.5
	13.2	13.5	11.9
	13.5	9.1	7.5
	9.0	9.5	8.6
	12.4	11.8	11.2
	14.0	10.0	11.8
Av	12.4	10.6	11.1
+b	22.0	21.9	20.5
	14.1	10.8	10.4
	21.5	21.8	21.8
	25.5	21.6	20.9
	24.5	21.8	22.1
	9.6	10.3	10.4
Av	19.5	18.0	17.7

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 74. Gardner color difference meter values of right raw 1-in. rib chops.<sup>1</sup>

	155°F	170°F	185°F
Rd	21.00	21.00	21.20
	18.98	18.48	16.55
	22.26	19.25	22.62
	19.27	18.52	17.42
	18.00	18.41	18.70
	18.48	18.55	20.18
Av	19.66	19.04	19.44
+a	-----	-----	12.1
	11.1	13.5	13.0
	9.7	9.0	8.5
	8.4	10.9	15.2
	11.0	11.2	15.0
	9.8	15.8	9.4
Av	10.0	12.1	12.2
+b	22.2	20.0	22.2
	4.9	00.9	10.4
	21.9	21.2	22.6
	24.5	22.5	20.4
	20.9	20.8	21.5
	15.2	11.8	14.5
Av	18.3	16.2	18.6

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 75. Gardner color difference meter values of side 1 of broiled 1-in. rib chops.<sup>1</sup>

	155°F	170°F	185°F
Rd	31.40	31.40	9.35
	27.95	25.35	23.18
	34.10	35.85	31.72
	33.75	34.20	24.10
	30.00	30.20	26.20
	25.50	32.10	29.80
Av	30.45	31.52	24.06
a	-1.00	0.00	+6.00
	+3.20	+2.70	+4.00
	0.00	-1.80	-2.60
	-2.10	-2.80	+1.70
	-2.00	-7.00	0.00
	+3.80	0.00	+0.50
Av	+0.30	-1.50	+1.60
+b	24.8	25.7	17.6
	10.8	11.3	12.6
	25.7	28.1	25.9
	25.2	26.0	25.8
	24.5	25.2	25.4
	10.8	11.9	14.9
Av	20.3	21.4	20.4

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 76. Gardner color difference meter values of side 2 of broiled 1-in. rib chops.<sup>1</sup>

	155°F	170°F	185°F
Rd	30.00	29.60	11.80
	28.05	26.50	11.82
	39.65	31.88	29.10
	33.68	36.00	24.48
	31.30	31.50	10.50
	30.06	30.20	27.50
Av	32.12	30.95	19.20
a	+14.9	-1.5	+6.5
	+ 1.3	+2.2	+5.4
	- 2.3	-1.5	0.0
	- 2.0	-1.0	+2.6
	- 5.0	0.0	+41.5
	+ 1.6	+0.5	+1.1
Av	+ 1.4	-0.2	+9.5
+b	25.6	24.9	21.0
	15.8	11.1	12.8
	27.4	26.2	26.9
	26.3	26.4	25.5
	26.0	25.4	20.0
	11.6	15.4	13.9
Av	22.1	21.6	20.0

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.



Table 77. Chop weights (g) of broiled 1-in. rib chops.

	155°F	170°F	185°F
Left loin	-----	-----	-----
	154.5	164.5	166.5
	179.0	189.5	188.0
	178.0	178.0	159.0
	151.0	137.0	138.5
	144.5	147.0	152.5
Av	161.4	163.2	160.9
Right loin			
	157.5	165.0	163.5
	156.0	157.5	160.0
	196.5	189.5	195.0
	170.0	182.0	164.5
	150.5	152.0	146.0
	160.5	155.5	158.0
Av	165.2	166.9	164.5

Table 78. Total cooking time (min) of broiled 1½-in. center loin chops.

	Right loin		Left loin	
	155°F	170°F	155°F	170°F
	27.0	31.0	28.0	-----
	28.0	32.0	28.0	38.0
	28.0	31.0	33.0	35.0
	28.0	18.0	27.0	34.0
	31.0	-----	27.0	18.0
	32.0	33.0	20.0	15.0
Av	29.0	29.0	27.2	28.0

Table 79. Cooking time (min) of broiled  $1\frac{1}{2}$ -in. center loin chops.

	Right loin		Left loin	
	155°F	170°F	155°F	170°F
	39.7	41.9	38.9	----
	47.2	53.8	48.2	59.6
	43.7	45.2	55.0	57.5
	52.5	33.2	48.4	54.1
	51.7	----	41.1	26.1
	57.0	49.2	34.6	25.3
AV	48.6	44.6	44.4	44.5

Table 80. Cooking losses (%) of broiled  $1\frac{1}{2}$ -in. center loin chops.

	Right loin		Left loin	
	155°F	170°F	155°F	170°F
	31.1	29.6	25.9	29.4
	19.1	32.6	24.0	30.6
	19.2	31.9	16.5	21.4
	26.8	28.8	20.4	28.4
	27.8	33.8	25.3	30.9
	28.6	29.6	25.9	29.1
Av	25.4	31.0	23.0	28.3

Table 81. Doneness, juiciness, and flavor (scores) of broiled  $\frac{1}{2}$ -in. center loin chops.

	Doneness		Juiciness		Flavor	
	155°F	170°F	155°F	170°F	155°F	170°F
	5.8	5.4	5.0	4.8	6.0	5.6
	5.6	5.4	6.2	4.6	6.2	5.8
	5.6	5.6	5.6	5.0	6.0	6.6
	5.6	5.8	5.2	4.8	5.2	5.4
	5.2	5.8	5.4	5.0	5.4	5.8
	6.2	5.2	5.4	5.4	6.0	5.4
Av	5.7	5.5	5.5	4.9	5.8	5.8

Table 82. Total moisture (%), pH, and shear values ( $\frac{1}{2}$ -in. cores) of broiled  $\frac{1}{2}$ -in. center loin chops.

	Total moisture		pH		Shear values	
	155°F	170°F	155°F	170°F	155°F	170°F
	60.9	68.4	5.70	5.78	5.4	5.0
67.1	59.8	5.72	5.80	3.6	5.2	
63.2	65.7	5.89	5.93	5.4	6.5	
61.7	61.3	5.72	5.88	4.8	5.8	
61.7	59.2	5.81	5.81	7.5	5.7	
59.0	57.6	5.80	5.90	6.6	4.7	
AV	62.3	62.0	5.77	5.85	5.6	5.5

Table 83. Tenderness and coagulum (scores) of broiled 1½-in. center loin chops.

	Tenderness		Tenderness		Coagulum	
	no. chops		score			
	155°F	170°F	155°F	170°F	155°F	170°F
	23.8	24.4	6.2	6.0	3.8	4.4
	23.8	22.6	6.2	6.2	4.8	4.4
	22.6	25.8	5.2	5.6	4.6	4.8
	26.4	22.4	5.6	6.2	6.0	6.2
	27.8	20.6	5.6	6.8	6.0	4.0
	20.6	25.8	6.6	5.8	3.2	2.2
AV	24.2	23.6	5.9	6.1	4.7	4.3

Table 84. Degree of brownness (scores) of broiled 1½-in. center loin chops.

	Side 1		Side 2	
	155°F	170°F	155°F	170°F
	5.4	4.0	4.2	5.8
	3.6	4.8	5.2	6.4
	4.0	4.0	3.8	6.4
	5.2	5.4	4.4	6.4
	5.6	6.0	5.4	6.8
	5.4	5.6	4.8	5.8
AV	4.9	5.0	4.6	6.3



Table 85. Uniformity of brownness (scores) of broiled  $1\frac{1}{2}$ -in. center loin chops.

	Side 1		Side 2	
	155°F	170°F	155°F	170°F
	2.4	3.6	4.6	3.0
	5.0	4.2	3.2	2.4
	6.2	4.8	6.4	2.6
	6.4	6.2	4.8	2.8
	5.8	5.0	4.8	3.0
	6.2	6.0	4.8	3.4
AV	5.3	5.0	4.8	2.9

Table 86. Gardner color difference meter values of side 1 of broiled 1½-in. center loin chops.<sup>1</sup>

	Rd		a		+b	
	155°F	170°F	155°F	170°F	155°F	170°F
	26.65	26.30	-1.5	-1.6	10.65	13.10
	29.00	29.00	+0.9	-2.2	11.60	14.60
	16.90	21.80	+9.8	-0.7	17.10	13.30
	24.20	23.90	+2.1	+1.3	15.95	13.20
	25.75	21.05	+4.9	+3.5	13.05	15.25
	25.25	22.70	+1.1	+0.6	10.80	13.40
AV	24.62	24.12	+2.88	+0.15	13.20	13.80

<sup>1</sup> See p. 43 for explanation of terms and abbreviations used in this table.

Table 87. Gardner color difference meter values of side 2 of broiled  $1\frac{1}{2}$ -in. center loin chops.<sup>1</sup>

	Rd					
	155°F	170°F	a		+b	
			155°F	170°F	155°F	170°F
	21.10	19.70	-1.1	+3.8	12.80	15.55
	24.15	16.90	+1.9	+3.9	17.20	15.90
	23.40	13.70	+3.7	+6.7	11.80	15.10
	25.00	29.10	+1.4	-10.5	11.80	12.60
	23.90	20.20	+5.0	+3.3	13.05	12.00
	33.00	21.10	-2.1	+4.3	12.00	15.30
AV	25.09	20.12	+1.47	+1.92	13.10	14.40

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 88. Gardner color difference meter values of right raw  $1\frac{1}{2}$ -in. center loin chops.<sup>1</sup>

	Rd		+a		+b	
	155°F	170°F	155°F	170°F	155°F	170°F
	23.70	22.00	6.30	5.95	10.6	19.90
20.70	21.05	8.20	7.65	10.4	10.15	
16.40	21.10	11.60	8.70	9.8	10.10	
17.90	17.20	10.80	11.40	10.5	19.90	
17.45	18.50	11.05	9.00	10.8	9.80	
17.45	18.40	11.05	11.10	10.4	10.50	
Av	18.93	19.70	9.83	8.97	10.4	13.40

<sup>1</sup> See p. 43 for explanation of terms and abbreviations used in this table.

Table 89. Gardner color difference meter values of left raw  $1\frac{1}{2}$ -in. center loin chops.<sup>1</sup>

	Rd		+a		+b	
	155°F	170°F	155°F	170°F	155°F	170°F
	18.11	29.10	9.50	3.70	10.2	10.0
	21.10	21.95	8.60	6.90	12.0	9.7
	17.80	20.60	8.65	10.50	9.3	9.5
	18.60	19.15	9.60	9.40	19.9	10.3
	19.90	20.85	8.10	8.20	19.8	10.9
	19.00	18.20	9.60	9.25	19.9	19.9
Av	19.07	21.64	9.01	7.99	15.2	11.7

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 90. Chop weights (g) for 1½-in. center loin chops.

	Right loin		Left loin	
	155°F	170°F	155°F	170°F
	309.0	336.0	326.5	358.5
	269.5	270.0	264.0	289.5
	291.0	311.5	272.5	276.5
	242.0	246.5	253.0	285.5
	272.0	291.5	298.0	313.5
	255.0	304.5	262.5	269.5
AV	273.1	293.3	279.4	298.8

Table 91. Total cooking time (min) of  $1\frac{1}{2}$ -in. rib chops.

	155°F	170°F	185°F
Right loin			
	24.0	31.0	31.0
	30.0	24.0	32.0
	31.0	34.0	30.0
	27.0	26.0	34.0
	15.0	24.0	34.0
	----	----	----
Av	25.4	27.8	32.2
Left loin			
	25.0	33.0	34.0
	29.0	28.0	36.0
	30.0	34.0	38.0
	13.0	28.0	38.0
	21.0	25.0	35.0
	----	----	----
Av	23.6	29.6	36.2

Table 92. Cooking time (min/lb) of  $1\frac{1}{2}$ -in. rib chops.

	155°F	170°F	185°F
Right loin			
	41.4	51.7	51.4
	52.6	42.6	56.9
	----	----	----
	58.6	67.3	60.1
	49.9	50.1	65.4
	30.6	44.9	62.0
Av	46.6	51.3	59.2
Left loin			
	48.3	57.2	59.5
	53.7	53.2	64.6
	----	----	----
	59.4	70.0	77.5
	23.1	53.6	75.2
	46.5	51.6	73.4
Av	46.2	57.1	70.0



Table 93. Cooking losses (%) of  $1\frac{1}{2}$ -in. rib chops.

	155°F	170°F	185°F
Right loin			
	26.8	33.1	36.3
	30.7	31.0	36.4
	----	----	----
	20.0	18.5	28.5
	26.7	20.8	33.9
	16.2	23.7	26.5
Av	24.1	25.4	32.3
Left loin			
	28.1	33.8	39.5
	30.6	29.1	35.6
	----	----	----
	24.0	26.5	28.3
	27.6	30.2	----
	12.7	22.3	26.6
Av	24.6	28.4	26.0

Table 94. Juiciness and flavor (scores) of broiled 1½-in. rib chops.

	155°F	170°F	185°F
Juiciness			
	5.6	5.4	5.0
	5.4	5.0	4.6
	---	---	---
	4.8	5.6	5.6
	6.0	5.8	6.0
	6.0	5.8	4.6
Av	5.6	5.5	5.2
Flavor			
	6.2	6.0	5.4
	6.0	5.2	6.2
	---	---	---
	5.6	6.0	6.4
	5.6	6.6	6.2
	5.8	5.6	5.6
Av	5.8	5.9	6.0

Table 95. Total moisture (%) and pH of broiled  $1\frac{1}{2}$ -in. rib chops.

	155°F	170°F	185°F
Total moisture			
	62.0	60.0	58.6
	62.1	59.8	55.2
	----	----	----
	65.5	65.1	61.2
	63.0	60.9	56.4
	67.6	66.0	61.4
Av	64.0	62.4	58.6
pH			
	6.20	6.25	6.22
	5.92	5.95	5.75
	----	----	----
	5.87	6.00	5.93
	6.10	6.06	6.11
	5.74	5.76	5.81
Av	5.97	6.00	5.96

Table 96. Doneness and coagulum (scores) of broiled  $1\frac{1}{2}$ -in. rib chops.

	155°F	170°F	185°F
<b>Doneness</b>			
	6.2	6.0	5.8
	5.6	5.6	5.6
	---	---	---
	5.6	5.6	6.2
	5.6	6.6	5.8
	6.0	5.6	5.8
<b>Av</b>	5.8	5.9	5.8
<b>Coagulum</b>			
	4.4	5.2	4.2
	3.4	4.2	1.6
	---	---	---
	6.2	5.6	5.0
	4.2	5.2	5.6
	4.8	4.6	3.6
<b>Av</b>	4.6	5.0	3.8

Table 97. Shear values ( $\frac{1}{8}$ -in. cores) of broiled  $1\frac{1}{4}$ -in. rib chops.

155°F	170°F	185°F
5.1	6.8	4.0
5.8	7.8	6.8
---	---	---
7.6	6.6	7.0
6.8	6.2	5.7
4.4	6.2	5.8
5.9	6.7	5.9

Table 98. Tenderness of broiled  $1\frac{1}{2}$ -in. rib chops.

	155°F	170°F	185°F
<b>No. chews</b>			
	19.0	21.8	21.0
	26.6	25.6	23.6
	----	----	----
	24.2	22.2	21.2
	18.0	21.6	19.0
	23.4	23.6	24.6
<b>Av</b>	22.4	23.0	21.9
<b>Scores</b>			
	6.6	6.4	6.4
	5.8	6.0	6.2
	---	---	---
	6.0	6.4	6.4
	7.0	6.4	6.6
	5.8	6.0	6.0
<b>Av</b>	6.2	6.2	6.3

Table 99. Degree of brownness (scores) of broiled  $1\frac{1}{2}$ -in. rib chops.

	155°F	170°F	185°F
Side 1			
	3.8	5.0	6.2
	4.6	5.2	6.2
	---	---	---
	4.8	4.6	6.2
	5.0	5.4	6.8
	4.2	5.0	5.8
Av	4.5	5.0	6.2
Side 2			
	5.2	4.4	6.4
	5.0	4.5	6.2
	---	---	---
	3.4	3.6	2.4
	5.0	5.8	6.6
	2.4	3.4	4.2
Av	4.2	4.3	5.2

Table 100. Uniformity of brownness (scores) of broiled  $\frac{1}{2}$ -in. rib chops.

	155°F	170°F	185°F
Side 1			
	4.8	5.2	4.8
	4.6	3.2	5.6
	---	---	---
	4.8	4.8	6.4
	5.2	4.4	3.0
	6.2	4.4	5.4
Av	5.1	4.4	5.0
Side 2			
	3.2	4.8	4.8
	2.4	4.0	4.0
	---	---	---
	5.4	4.6	4.8
	3.4	2.8	3.4
	5.6	4.2	4.2
Av	4.0	4.1	4.2



Table 101. Gardner color difference meter values of left raw  $1\frac{1}{2}$ -in. rib chops.<sup>1</sup>

	155°F	170°F	185°F
Rd	16.05	15.20	15.90
	11.52	21.85	26.25
	20.10	19.20	17.75
	-----	-----	-----
	22.55	19.90	22.25
	20.60	7.10	19.40
Av	18.16	16.65	20.31
+a	12.25	12.75	10.92
	6.16	6.75	6.05
	10.60	11.50	12.55
	-----	-----	-----
	7.85	18.50	8.45
	7.90	12.30	10.40
Av	8.95	12.36	9.67
+b	7.40	8.20	7.75
	10.28	10.00	9.26
	10.72	10.80	10.45
	-----	-----	-----
	13.25	15.00	10.20
	9.80	10.65	10.40
Av	10.30	10.93	9.60

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 102. Gardner color difference meter values of right raw  $1\frac{1}{2}$ -in. rib chops.<sup>1</sup>

	155°F	170°F	185°F
Rd	19.50	17.95	17.45
	19.20	19.55	19.50
	18.50	18.60	19.05
	23.50	20.90	19.25
	13.05	14.85	14.70
	-----	-----	-----
Av	18.75	18.37	17.99
+a	6.75	11.45	10.80
	6.70	7.40	6.90
	10.30	12.20	10.10
	7.90	9.60	10.40
	10.90	10.00	9.55
	-----	-----	-----
Av	8.50	10.13	9.55
+b	8.30	6.40	7.20
	7.75	7.52	6.15
	10.22	10.12	10.18
	10.50	10.05	10.55
	7.05	8.50	10.20
	-----	-----	-----
Av	8.80	8.50	8.90

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 103. Gardner color difference meter values of side 1 of broiled  $1\frac{1}{2}$ -in. rib chops.<sup>1</sup>

	155°F	170°F	185°F
Rd	17.62	26.98	22.05
	31.50	22.40	38.50
	23.18	22.75	16.30
	21.50	25.00	-----
	23.90	-----	-----
	-----	-----	-----
Av	23.54	24.28	25.62
a	+1.14	-----	+2.00
	-0.60	+2.10	+9.40
	+3.75	+3.82	+7.32
	+3.90	+1.70	-----
	+3.70	-----	-----
	-----	-----	-----
Av	+2.38	+2.54	+6.24
+b	18.65	12.68	15.10
	13.75	21.40	20.20
	17.65	16.05	14.88
	10.70	14.30	-----
	13.15	-----	-----
	-----	-----	-----
Av	14.78	16.11	16.73

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 104. Gardner color difference meter values of side 2 of broiled  $1\frac{1}{2}$ -in. rib chops.<sup>1</sup>

	155°F	170°F	185°F
Rd	18.08	29.10	29.90
	30.62	30.10	20.40
	24.35	26.82	24.48
	30.20	31.05	22.80
	26.40	-----	6.05
	-----	-----	-----
Av	25.93	29.27	20.73
a	+4.25	+2.10	-----
	-----	-----	+2.10
	+4.40	-3.00	+1.80
	-0.70	-2.10	+0.90
	-3.30	-----	+3.30
	-----	-----	-----
Av	+1.16	-1.00	+2.02
+b	13.56	21.80	10.00
	14.80	13.05	14.55
	13.05	11.55	8.98
	11.30	9.70	10.90
	10.80	-----	1.22
	-----	-----	-----
Av	12.70	14.02	9.13

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 105. Chop weights (g) of broiled  $1\frac{1}{2}$ -in. rib chops.

	155°F	170°F	185°F
<b>Left loin</b>			
	235.0	262.0	259.5
	245.0	239.0	253.0
	-----	-----	-----
	229.5	220.5	222.5
	255.5	237.0	229.5
	205.0	220.0	216.5
<b>Av</b>	234.0	235.7	236.2
<b>Right loin</b>			
	263.5	272.0	274.0
	259.0	256.0	255.5
	-----	-----	-----
	240.0	229.5	226.5
	245.0	235.5	236.0
	222.5	242.5	249.0
<b>Av</b>	246.0	247.1	248.2



VIII	Rib	155 <sup>5</sup> 1½								
		170	14	0.99	5.27	1.99	3.07	9.17	2.76	6.96 2.50
		185								
	LSD*			----	3.77	----	----	0.20	----	1.27 ----

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

<sup>3</sup>For total (min) and cooking time (min/lb), D.F. = 9.

<sup>4</sup>For cooking losses (left), D.F. = 14, for total cooking time (left, min), D.F. = 15 and cooking time (left, min/lb), D.F. = 13.

<sup>5</sup>For cooking losses (left), D.F. = 13.

Table 107. "t and F" values for chop weight (g), tenderness (scores), shear values ( $\frac{1}{8}$ -in. cores), flavor, and doneness of center loin, shoulder, and rib chops.<sup>1,2</sup>

Group	Treatment			D.F.	Chop weight	Tenderness	Shear values	Flavor	Doneness
		$\sigma^2$	in.						
I	Center loin	170 <sup>3</sup>	$\frac{1}{8}$ $\frac{3}{4}$	10	5.16	1.68	----	1.00	0.28
II	Shoulder	170 <sup>3</sup>	$\frac{1}{8}$ $\frac{3}{4}$	10	0.00	1.68	----	0.183	0.00
III	Rib	170 <sup>3</sup>	$\frac{1}{8}$ $\frac{3}{4}$	10	0.00	4.02	----	0.04	0.37
IV	Rib	185 <sup>3</sup>	$\frac{1}{8}$ $\frac{3}{4}$	10	0.00	3.33	----	0.06	1.52
V	Center loin	155 <sup>3</sup> 170	1	10	0.04	3.02	1.24	0.18	0.03
VI	Rib	155 <sup>3</sup> 170 185	1	17	0.10	0.34	0.75	0.99	0.24
VII	Center loin	155 <sup>3</sup> 170	$1\frac{1}{8}$	10	2.99	0.54	0.01	0.02	0.64



VIII	Rib	1554	1½						
		170		14	0.68	0.08		0.97	----
		185							0.08

---

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

<sup>3</sup>For chop weight, D.F. = 22.

<sup>4</sup>For chop weight, D.F. = 29.

Table 108. "t and F" values for uniformity and degree of brownness (scores), coagulum (scores), and pH.<sup>1,2</sup>

Group	Treatment	F	in.	D.F.	Degree of Brownness		Uniformity of brownness		Coagulum	pH
					Side 1	Side 2	Side 1	Side 2		
I	Center loin	170 <sup>3</sup>	$\frac{1}{2}$ $\frac{3}{4}$	10	1.05	0.019	6.93*	0.05	0.95	1.09
II	Shoulder	170	$\frac{1}{2}$ $\frac{3}{4}$	10	0.06	0.050	3.62	5.21*	3.98	----
III	Rib	170	$\frac{1}{2}$ $\frac{3}{4}$	10	0.40	4.14	0.67	1.27	2.22	0.30
IV	Rib	185	$\frac{1}{2}$ $\frac{3}{4}$	10	1.04	0.22	1.26	0.10	0.04	0.12
V	Center loin	155 170	1	10	1.05	4.62	9.66*	5.32*	0.60	0.13
VI	Rib	155 170 185	1	17	9.03	2.73	4.0	3.41	5.10	0.76
	LSD*				0.85	----	0.78	----	1.22	----

VII	Center loin	155	1 $\frac{1}{2}$	10	0.04	30.24**	0.24	18.78**	0.32	3.67
		170								
VIII	Rib	155	1 $\frac{1}{2}$	14	7.07	0.70	0.90	0.08	1.18	0.01
		170								
		185								
	LSD*			0.53	----	----	----	----	----	----

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

<sup>3</sup>For pH, D.F. = 9.

Table 109. "t and F" values for Gardner color difference meter values of broiled center loin, shoulder, and rib chops.<sup>1,2</sup>

Group	Treatment	F	in.	D.F.	Rd		+a		+b	
					Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
I	Center loin	170	$\frac{1}{2}$ $\frac{3}{4}$	10	0.60	3.84	0.26	2.47	0.69	2.17
II	Shoulder	170	$\frac{1}{2}$ $\frac{3}{4}$	--	----	----	----	----	----	----
III	Rib	170	$\frac{1}{2}$ $\frac{3}{4}$	10	1.10	.48	0.79	0.05	0.08	3.14
IV	Rib	185	$\frac{1}{2}$ $\frac{3}{4}$	--	----	----	----	----	----	----
V	Center loin	155 170	1	10	0.00	.15	0.00	0.80	2.52	1.04
VI	Rib	155 <sup>3</sup> 170 185	1	17	3.36	8.95	0.94	1.33	0.04	0.18
	LSD*				----	7.20	----	----	----	----

VII	Center loin	155	1½	10	0.06	3.42	2.22	0.03	0.27	1.43
		170								
VIII	Rib	155	1½	14	0.10	2.14	2.63	1.06	0.35	1.70
		170								
		185								

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<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

<sup>3</sup>For  $t_a$  (right), D.F. = 15.

Table 110. "t and F" values for Gardner color difference meter values for raw center loin, shoulder, and rib.<sup>1,2</sup>

Group	Treatment	°F	in.	D.F.	Rd		+a		+b	
					Side 1	Side 2	Side 1	Side 2	Side 1	Side 2
I	Center loin	170 <sup>3</sup>	$\frac{1}{8}$ $\frac{3}{4}$	10	1.21	0.03	2.37	0.00	.14	.02
II	Shoulder	170	$\frac{1}{8}$ $\frac{3}{4}$	--	----	----	----	----	----	----
III	Rib	170 <sup>4</sup>	$\frac{1}{8}$ $\frac{3}{4}$	10	0.00	0.21	0.53	0.34	0.73	2.17
IV	Rib	185	$\frac{1}{8}$ $\frac{3}{4}$	10	0.71	0.09	0.75	0.40	0.19	8.06*
V	Center loin	155 170	1	10	0.92	0.00	1.03	2.72	0.00	2.33
VI	Rib	155 170 185	1	17	1.48	0.20	1.03	1.44	0.16	0.20
VII	Center loin	155 170	$1\frac{1}{8}$	10	2.40	0.32	0.98	0.52	1.66	2.08

VIII	Rib	155 <sup>5</sup>	1 $\frac{1}{2}$						
		170		11	0.72	0.09	1.63	1.04	0.55
		185							0.05

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<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

<sup>3</sup>For Rd, +a, and +b (side 2), D.F. = 9.

<sup>4</sup>For +a (side 1 and 2), D.F. = 9.

<sup>5</sup>For +a (side 1 and 2), D.F. = 10, for Rd and +b (side 2), D.F. = 13.

Table 111. "t and F" values for thicknesses of rib and center loin chops  
(155°F). 1, 2, 3

Treatments	Total moisture (%)		Total cooking time (min)		Cooking losses (%)		Gardner color difference meter values							
	D.F.	D.F.	D.F.	D.F.	D.F.	D.F.	Rd	+a	+b	D.F.	D.F.	D.F.		
Rib	155	1	9	0.03	20	25.34**	19	0.20	20	12.61**	19	0.18	20	10.68**
		1½												
Center loin	155	1	10	1.51	22	58.32**	22	0.40	22	2.53	22	0.07	22	2.50
		1½												
Center loin	170	1	23	1.585	44	42.16**	47	14.35**	46	3.45*	46	0.69	46	5.37**
		1½												
Rib	170	1	22	0.396	43	75.527**	43	2.94*	43	2.85*	38	0.37	43	11.54**
		1½												
Rib	185	1	22	2.778	43	1.953	44	61.53**	43	4.79	38	1.58	43	10.29
		1½												
LSD		1½	----		----		----		5.86		----			2.82



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<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>"t" tests determined for rib (155°F) and center loin (155°F), analyses of variance for all other groups.

<sup>3</sup>Averages of left plus right loin were used for statistical determination of all factors except for Gardner color difference meter values (average of side 1 plus 2).

Table 112. "t and F" values for sectional comparisons of broiled chops. 1,2,3

Treatments	Total moisture (%)		Total cooking time (min)		Cooking losses (%)	
	D.F.		D.F.		D.F.	
$\frac{1}{2}$ -in. 170°F	11	4.96	34	51.11**	34	18.64**
$\frac{3}{4}$ -in. 170°F	11	5.60	35	48.93	35	4.79*
1-in. 155°F	10	.01	22	16.90**	10	.04
1-in. 170°F	10	1.03	20	12.16**	21	1.17
$1\frac{1}{2}$ -in. 155°F	9	1.26	20	2.91	20	.00
$1\frac{1}{2}$ -in. 170°F	9	.03	18	.00	20	2.32

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Analyses of variance determined for rib, center loin, and shoulder comparisons, "t" tests for all other comparisons.

<sup>3</sup>With average total cooking time and cooking losses for  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. 170°F chops, rib, center loin, and shoulder comparisons were made. For all other average data, rib and center loins were compared.

Table 113. "t" values for Gardner color difference meter values for rib versus center loin broiled chops. 1,2

Treatments	Rd		+a		D.F.	
	D.F.		D.F.			
$\frac{1}{2}$ -in. 170°F	22	1.01	20	6.74*	22	6.61*
$\frac{3}{4}$ -in. 170°F	23	7.26*	22	1.15	23	.11
1-in. 155°F	22	38.63**	22	.50	21	21.68**
1-in. 170°F	22	22.81**	22	15.65**	22	18.06**
$1\frac{1}{2}$ -in. 155°F	20	.00	19	.42	20	.31
$1\frac{1}{2}$ -in. 170°F	18	6.23*	16	.02	18	.50

1 See p. 43 for explanation of terms and abbreviations used in this table.  
 2 Average of side 1 plus 2.

Table 114. "t and F" values for cooking losses (%), chop weights (g), and total cooking time (min) of right versus left rib and center loin chops.<sup>1,2,3</sup>

	D.F.	Cooking losses	Total cooking time	Chop weight
<b>Rib</b>				
$\frac{1}{2}$ -in.				
170°F	10	0.001	0.026	0.150
185°F	10	0.445	0.890	0.273
$\frac{3}{4}$ -in.				
170°F	10	0.697	0.368	0.554
185°F	10	0.363	1.424	0.014
1-in.				
155°F <sup>4</sup>	9	0.019	1.353	0.144
170°F	9	0.049	0.003	0.111
185°F	9	0.001	5.420*	0.118
$1\frac{1}{2}$ -in.				
155°F	8	0.016	0.181	1.147
170°F	8	0.742	0.469	1.107
185°F <sup>5</sup>	8	0.002	12.500**	1.034
<b>Center loin</b>				
$\frac{1}{2}$ -in.				

170°F	10	1.263	0.008	0.008
$\frac{3}{4}$ -in.				
170°F	10	3.677	1.391	2.790
1-in.				
155°F	10	1.147	0.266	1.177
170°F <sup>6</sup>	10	0.013	0.012	0.365
$1\frac{1}{2}$ -in.				
155°F	10	0.885	0.943	0.178
170°F <sup>7</sup>	10	2.784	0.032	0.087

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>Analyses of variance determined for Groups VI and VIII, "t" tests for all other groups.

<sup>3</sup>Average of left plus right loins.

<sup>4</sup>For total cooking time, D.F. = 10.

<sup>5</sup>For cooking losses, D.F. = 7.

<sup>6</sup>For total cooking time, D.F. = 9.

<sup>7</sup>For total cooking time, D.F. = 8.

Table 115. "t" values for Gardner color difference meter values for left versus right rib and center loin uncooked chops.<sup>1,2</sup>

	Center loin		Rib	
	D.F.		D.F.	
Rd	8	.425	8	.296
+a	7	-.253	7	.482
+b	7	.684	8	1.177

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

<sup>2</sup>"t" values obtained for averages of data for each section for each animal.

Table 116. Average Gardner color difference meter values for raw chops from center loin sections of identical animals.<sup>1</sup>

	Rd		+a		+b	
	Right loin	Left loin	Right loin	Left loin	Right loin	Left loin
	18.34	18.90	10.61	9.50	10.20	14.65
	17.51	15.40	10.62	10.48	9.70	9.66
	17.14	17.22	10.45	11.58	10.40	10.55
	21.86	22.56	7.02	7.18	12.76	10.48
	17.76	19.36	10.56	8.82	12.75	15.22
	16.86	16.45	9.41	10.62	10.41	9.74
	20.48	19.83	7.89	8.81	8.72	8.77
	16.64	18.66	11.35	9.84	9.19	9.04
AV	18.32	18.55	9.74	9.63	10.52	11.01

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.

Table 117. Average Gardner color difference meter values for raw chops from rib sections of identical animals.<sup>1</sup>

	Rd				+a				+b			
	Right loin	Left loin	Right loin	Left loin	Right loin	Left loin	Right loin	Left loin	Right loin	Left loin	Right loin	Left loin
	20.03	21.75	9.22	8.99	11.56	10.38						
	16.09	13.67	10.00	9.96	9.65	8.30						
	20.91	21.14	7.46	8.15	12.07	9.71						
	18.72	19.12	12.03	11.87	17.45	16.45						
	21.22	21.57	9.30	11.60	10.37	12.82						
	16.25	15.71	9.91	11.09	7.94	9.03						
	19.07	19.44	8.93	8.94	8.66	10.25						
	19.54	20.32	12.42	12.65	13.43	16.62						
	19.89	20.00	10.28	9.53	22.18	22.18						
AV	19.08	19.19	9.95	10.31	12.59	12.86						

<sup>1</sup>See p. 43 for explanation of terms and abbreviations used in this table.



THE EFFECT OF END POINT TEMPERATURE, THICKNESS, AND SECTION  
ON ACCEPTABILITY OF BROILED PORK CHOP FROM  
RIGHT AND LEFT LOINS

by

ZOE ANN HOLMES

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The effect of end point temperature, thickness, and section on acceptability of broiled pork chops from right and left loins was investigated. Shoulder ( $\frac{1}{2}$  and  $\frac{3}{4}$ -in., 170°F), center loin ( $\frac{1}{2}$  and  $\frac{3}{4}$ -in., 170°F; 1 and  $1\frac{1}{2}$ -in., 170 and 185°F), and rib chops ( $\frac{1}{2}$  and  $\frac{3}{4}$ -in., 170 and 185°F; 1 and  $1\frac{1}{2}$ -in., 155, 170 and 185°F) were cut from 12 paired loins.

Generally, juiciness scores, total moisture, cooking losses, and total cooking times tended to increase with thickness. With  $\frac{1}{2}$  to  $\frac{3}{4}$ -in. rib chops (185°F) the increase was significant for moisture value. Total cooking time increased with thickness ( $P < .01$ ) for right and left shoulder (170°F) and rib (170 and 185°F) and for right loin chops (170°F). With higher end point temperatures, juiciness scores and total moisture were lower, cooking losses greater and total cooking times longer. Juiciness of center loin and rib chops of the same thickness decreased with the 1-in. rib chop being less juicy ( $P < .05$ ) at 185°F than at 155 or 170°F and the  $1\frac{1}{2}$ -in. center loin chops less juicy ( $P < .05$ ) at 170 than at 155°F.

Tenderness, flavor, doneness, and coagulum scores and pH or shear values were not significantly affected by thickness. However, flavor was similar or increased slightly with increasing temperature or thickness. Coagulum scores tended to decrease with increasing temperature, indicating more coagulum present. In general, reflectance values and degree of brownness scores indicated that chops became browner with increasing thickness (center loin and rib chops) and temperature (center

loin). Degree of brownness scores for 1-in. rib chops (side 1) were higher ( $P < .05$ ) at 185 than 155 or 170°F. However, for shoulder chops, degree of brownness decreased ( $P < .05$ ) as thickness increased and as temperature increased for 1-in. center loin ( $P < .01$ ). Increasing temperature from 155 to 170 to 185°F, chops became browner ( $P < .05$ ) for side 1 of  $1\frac{1}{2}$ -in. rib chops. Uniformity of brownness usually decreased with increased thickness. For rib chops, no consistent trends were observed for reflectance or uniformity of brownness with increasing end point temperatures.

Sectional differences were observed with total cooking time and cooking losses significantly higher for  $\frac{1}{2}$  and  $\frac{3}{4}$ -in. shoulder chops (170°F) than for comparable rib or center loin chops. On the whole, center loin chops had higher total moisture values than rib chops. Total cooking time was longer ( $P < .01$ ) and cooking losses higher for 1-in. center loin than 1-in. rib chops at 155 and 170°F. Generally, reflectance was lower for the center loin than for the rib chops. Also, a slight trend toward higher redness values and lower yellowness values was indicated for center loin chops. Of 48 comparisons of right and left chops, only in 2-cases were significant differences noted. The 1 ( $P < .05$ ) and  $1\frac{1}{2}$ -in. ( $P < .01$ ) rib chops broiled to 185°F had significantly longer total cooking times for the left than for right side.