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To the Graduate Council:

I am submitting herewith a thesis written by Marilyn McCammon Davenport entitled "Yield, Cost, and Acceptability of Beef Sirloin Roasted by Forced Convection at Two Oven Temperatures." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Food Science.

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YIELD, COST, AND ACCEPTABILITY OF BEEF SIRLOIN ROASTED
BY FORCED CONVECTION AT TWO OVEN TEMPERATURES.

A Thesis
Presented to
the Graduate Council of
The University of Tennessee

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Master of Science

by
Marilyn McCammon Davenport

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M. M. D.

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CHAPTER I

INTRODUCTION

The relationship of numerous factors to yield and palatability of meat has been under investigation for many years. Since meat is the most costly menu item for institutional food establishments, factors which affect yield, cost, and palatability are of primary concern to food service managers.

With the development of forced convection ovens a relatively new approach to meat cookery was introduced to the food service industry. Borsenik and Newcomer (1959) pioneered in the development of forced convection cookery by installing a blower in a conventional oven. They found that cooking time was reduced and fuel consumption was decreased with forced convection. In 1961, Schoman and Ball reported that time for roasting meat was decreased and yield was increased by the use of an oven designed to be operated with increased pressure and forced air circulation. In a recent investigation Funk et al. (1966) also reported that forced convection shortened cooking time.

Traditionally beef is roasted at approximately 300° F. for both home and institutional uses. However, some evidence has been acquired that lower oven temperatures have a tendering effect on meat without impairment of other sensory properties. Cover (1943) was one of the first to report that slow rates of heat penetration had a tendering

effect on beef. Further evidence that lower oven temperatures, under some conditions, produced more tender meat was reported by Griswold (1955), Bramblett et al. (1959), Bramblett and Vail (1964), Simmers (1965), Nielsen and Hall (1965), and Fugate (1967).

Since forced convection shortens the cooking time due to faster heat penetration whereas slow heat penetration seems to favor the tendering of meat, the question can be raised of whether lower oven temperature would be advantageous when roasting by forced convection. The purpose of this study was to compare acceptability, cooking losses, cooking time, shear values, yield of usable meat, and raw food cost per serving for pairs of beef sirloin butts roasted at 200 and 300° F. in gas forced convection ovens. Eight pairs of roasts were tested. Data were analyzed by a t-test to determine significance of differences associated with oven temperature.

CHAPTER II

REVIEW OF LITERATURE

Research on the use of forced convection for roasting beef and the relationship of different oven temperatures to sensory properties, cooking losses, and cooking time for beef will be reviewed in this chapter. For ease of comparison, all temperatures are expressed in the Fahrenheit scale, even though some authors reported Centigrade temperatures.

I. FORCED AND NATURAL CONVECTION ROASTING OF BEEF

Borsenik and Newcomer (1959) cooked ground beef loaves to 170° F. at 250 and 350° F. in a conventional oven and in a conventional oven modified by the installation of a blower. They found that neither oven temperature nor method of heat convection affected the yield of cooked meat. At both oven temperatures cooking times and fuel consumption were decreased with forced convection heating.

Using paired halves of top round of beef, Schoman and Ball (1961) compared forced convection roasting in a specially designed oven with natural convection roasting. Several combinations of oven temperature, air velocity, and steam pressure were tested in the experimental oven. Rounds roasted at 300° F. to an internal temperature of 150° F. by natural convection at atmospheric pressure had a yield of 72.5 per cent and a cooking time of 1.7 minutes per ounce. The

combined best results for operation of the specially designed oven were: temperature, 200-237.5° F.; air velocity, 10-20 cubic feet per minute; and steam pressure, 5-10 pounds per square inch. Under the above range of conditions roasting losses decreased approximately 8 per cent and roasting time 15 per cent ($P < .005$) as compared to natural convection roasting. The disadvantages of the saturated steam atmosphere were the moist-heat aroma and texture of the roasted product. Although the moist-heat aroma disappeared quickly, the texture remained that of a moist-heated roast.

Funk et al. (1966) compared the effects of forced and natural convection roasting at 300° F. on heat penetration rates in loin roasts of beef. Heat penetration was faster in the forced convection oven than in the natural convection oven; roasts cooked by forced convection required 18 per cent less time to reach an internal temperature of 126° F. than similar cuts in the conventional oven. The authors suggested that the faster rate of heat penetration in the forced convection oven could have been due to the removal of the stagnant air film from the surface of the roast by the circulating air; presence of moisture from a pan of boiling water; and less temperature fluctuation. In their study scores for all palatability factors (aroma, color and flavor of lean, flavor of fat, juiciness, and tenderness) did not differ significantly for the two methods of roasting. Likewise, Warner-Bratzler shear values and Kramer shear-press values did not differ significantly for the two methods of roasting. Total cooking losses for the roasts cooked by forced

convection were 15.22 per cent. These were significantly greater ($P < .01$) than the 12.49 per cent losses for roasts cooked by natural convection. Volatile losses averaged 9.92 per cent for the forced-convection-cooked roasts and 8.40 per cent for the conventionally cooked roasts. This difference was significant also ($P < .05$). No significant differences were found in the drip losses or yields of servable meat. For further investigation of forced convection roasting the authors recommended: use of different oven temperatures; and, omitting the pan of water.

II. SENSORY PROPERTIES, COOKING LOSSES, AND COOKING TIME FOR BEEF IN RELATION TO OVEN TEMPERATURE

Interest has existed for many years in the relationship of oven temperature to the sensory properties of roasted meat, particularly tenderness. The effect of oven temperature on tenderness of meat, however, remains a controversial issue.

Cover (1943) was one of the first investigators to report the effects of extremely slow rates of heat penetration on the tendering of beef. Paired bottom round roasts cooked at 176° F. were more tender than those cooked at 257° F., as determined by panel scores and shear values. She attributed the increased tenderness obtained with the lower oven temperature to the slower rate of heat penetration which increased the time during which the meat was maintained in the temperature range favorable to the conversion of collagen to gelatin. Roasts cooked at 176° F. were scored tender whenever the heat penetration

was slow enough so that it required at least thirty hours for the meat to lose its pink color; the connective tissue in these well-done roasts was a moist viscous mass, but that of their pair-mates cooked for six hours at 257° F. was resistant to mastication. It was suggested that the water of hydration was released slowly enough at the lower temperature to permit some conversion of collagen to gelatin. Total cooking losses were 32.7 per cent for roasts cooked at 176° F. and 32.6 per cent for those cooked at 257° F.

Griswold (1955) roasted top and bottom round of beef of U.S. Prime and Commercial grades at 250 and 300° F. to an internal temperature of 185° F. Tenderness, aroma, flavor of lean, and acceptability scores for meat roasted at 250° F. were slightly but not significantly higher than scores for meat roasted at 300° F. However, shear values were lower for the roasts cooked at 250° F. ($P < .05$). Roasts cooked at 300° F. were juicier ($P < .05$) than roasts cooked at 250° F. Cooking losses of U.S. Commercial grade roasts were 8.8 per cent higher at 250° F. than at 300° F.

Bramblett et al. (1959) oven roasted paired beef round muscles wrapped in aluminum foil for eighteen hours at 155° F. or for thirty hours at 145° F. Muscles cooked at 145° F. were more tender as evaluated by Warner-Bratzler shear and by taste panel ($P < .01$) than muscles cooked at 155° F. Juiciness, texture, and appearance scores were significantly higher for muscles cooked at 145° F. than at 155° F. Total cooking losses at 145° F., 23.5 per cent, were lower ($P < .01$) than the 27.9 per cent loss at 155° F.

In a later study Bramblett and Vail (1964) roasted paired beef round muscles of U.S. Good and Standard grades wrapped in aluminum foil at 155 and 200° F. to an end point of 149° F. Roasts of U.S. Good grade cooked at 155° F. were more tender as evaluated by taste panel and by Warner-Bratzler or L.E.E.-Kramer shears ($P < .01$) than paired muscles cooked at 200° F. Juiciness scores for roasts cooked at 155° F. were lower ($P < .05$) and cooking losses greater ($P < .01$) than for those cooked at 200° F. For U.S. Standard grade roasts only L.E.E.-Kramer shear-press values were lower ($P < .05$) for roasts cooked at 155° F. than at 200° F.

Paired roasts consisting of the semimembranous muscle from top round of beef were cooked at 200° F. to 154° F. and at 300° F. to 158° F. by Simmers (1965). Roasts cooked at 200° F. were more tender ($P < .05$) as determined by shear values and sensory evaluations, but roasts cooked at 300° F. were juicier ($P < .05$). Flavor of the roasts was not affected by oven temperature. Roasts cooked at 200° F. required about three times as long to cook as those roasted at 300° F. Total cooking losses were higher ($P < .01$) for roasts cooked at 200° F. than at 300° F.

Blade and rump cuts were roasted at oven temperatures of 225 and 325° F. to 160° F. internal temperature by Nielsen and Hall (1965). Shear values for blade roasts cooked at 225° F. were significantly lower than those of pair-mates roasted at 325° F., but this difference in tenderness was not reflected in panel scores. Differences in shear values or panel scores of rump cuts roasted at 225 and 325° F. were

not significant. No significant differences were obtained in juiciness scores for blade or rump cuts roasted at the two oven temperatures. Blade roasts cooked at 225° F. had greater ($P < .01$) total cooking losses (26.2 per cent) than those roasted at 325° F. (16.7 per cent). However, there was no difference in total cooking losses of rump roasts cooked at the two oven temperatures.

Hunt et al. (1963) were among the investigators who failed to obtain an increase in tenderness with reduced oven temperature. They obtained no significant differences in Warner-Bratzler shear values for top round of beef roasted at eight oven temperatures (200, 225, 250, 275, 300, 325, 350, and 375° F.) to three internal temperatures (140, 158, and 176° F.). Although yields decreased and total cooking losses increased with increases in internal temperature ($P < .01$), neither yield nor total cooking loss was affected by oven temperature. Cooking time per pound decreased significantly with successively higher oven temperatures, whereas the time required to cook the roasts increased significantly with increases in internal temperature.

In a similar investigation Fugate (1967) studied beef rib cuts roasted at 225 and 325° F. to end points of 140, 158, and 170° F. Roasts cooked at 225° F. to end points of 158 or 170° F. were more tender ($P < .01$) as determined by shear values and sensory evaluations than roasts cooked to the same end points at 325° F.; however, at an end point of 140° F., tenderness was not affected by oven temperature. Juiciness scores decreased as internal temperatures increased and were affected by oven temperature only at the 170° F. end point, in

which case the roasts cooked at 325° F. were juicier ($P < .01$) than those at 225° F. Mean flavor scores ranged from "good" to "very good" for all the roasts. Total cooking losses were greater ($P < .01$) for roasts cooked at the higher oven temperature when the end point was 140 or 158° F. Total cooking losses increased ($P < .01$) at both oven temperatures with each increase in end point. Cooking time was more than twice as long for roasts cooked at 225° F. as at 325° F.

CHAPTER III

PROCEDURE

Pairs of fresh U.S. Good boneless beef sirloin butts from the same animal were procured from a local packing plant. This cut of beef was selected because it was being used by the Department of Food Services. The roasts were received from the packing company the day prior to cooking and stored unwrapped in aluminum pans in a walk-in refrigerator (36-40° F.).

One pair of roasts was cooked on each of eight days in gas forced convection ovens, one at 200° F. and the pair-mate at 300° F. The weights of the roasts ranged from fourteen to twenty pounds and averaged eighteen pounds for the sixteen roasts. On the day of testing, each roast was weighed to the nearest 0.5 ounce. A five-inch long stainless-steel dial type thermometer (Koch), registering in the Fahrenheit scale, was inserted into the approximate geometric center of the gluteus medius muscle.

Roasts were cooked fat side up on metal racks in shallow aluminum pans. The ovens were preheated to 200 or 300° F., and roasting was started so that both roasts of a pair would be ready for evaluation at approximately the same time. Ovens were operated with the vents open. Roasts were cooked until the internal temperature reached 165° F. in the gluteus medius muscle. Preliminary tests indicated that this end point, at both oven temperatures, would yield the well-done stage to which this cut of beef was customarily

cooked by the department. The roasts which had been cooked at 300° F. were cooled for one hour after removal from the oven, and roasts cooked at 200° F. were cooled for one-half hour. During these cooling periods the maximum temperature rise was attained and recorded. Total cooking time was recorded. Appropriate weights were taken before cooking and after the cooling period for determination of total, volatile, and drip cooking losses.

Roasts were removed from the roasting pans to tared sheet pans, on which they were trimmed and sampled for testing. First, the fat covering was removed from each roast. Then each roast was cut approximately in half, and the end containing the gluteus medius muscle was cut in half across the grain. A sample of the gluteus medius muscle, two-inches in depth, was removed from the interior of the roast by cutting across the muscle fibers. This sample section was used for all objective and subjective testing.

An objective index to tenderness was obtained by use of a Warner-Bratzler shear. Three cores, one-inch in diameter, cut parallel to the muscle fibers, were removed from the sample section of the gluteus medius muscle. The cores were cooled for approximately five hours at room temperature before being sheared. Each core was sheared three times, and the mean of the nine shear values was calculated for each roast.

Samples for sensory evaluation were removed after the cores were removed. Three slices of meat approximately three-eighths-inch thick were carved from each roast. Each judge scored three coded

samples. Two were paired samples obtained from the same location from the first or second slice of each roast. The third sample was obtained randomly, and the order of sample presentation was randomized. An attempt was made to serve warm samples.

The sensory panel consisted of employees of the Department of Food Services and included two dietitians, two experienced meat cooks, and one food service supervisor. The panel members were trained for two months before participating in this study. The procedures and cut of beef used in the training period were the same as those used in this study. Panel members scored each sample for flavor, juiciness, and tenderness on a nine-point desirability scale (see Appendix).

After the roasts were sampled for subjective evaluations, each was trimmed of excess fat and unusable lean. Then the usable remainder of the roast was removed from the tared sheet pan, and the pan, with fat and lean scraps and juices, was weighed to determine trimming loss. The cooked weight of the roast minus the trimming loss represented the weight of usable meat. From the yield of usable meat the number of 2.5-ounce servings obtained per pound of raw meat was calculated. The raw food cost per 2.5-ounce serving also was calculated.

The raw weight of each roast was used in calculating the cooking time in minutes per pound and the percentages of cooking loss and yield. Means were calculated for each of the objective and subjective measurements made. The data were analyzed by Student's t-test for significance of differences associated with oven temperature.

CHAPTER IV

RESULTS AND DISCUSSION

I. EFFECT OF OVEN TEMPERATURE ON COOKING

LOSSES AND COOKING TIME

Cooking losses. Volatile, drip, and total cooking losses were significantly higher for roasts cooked at 300° F. than at 200° F. (Table I). Volatile, drip, and total cooking losses at 300° F. were higher than the losses reported by Funk et al. (1966) for loin cuts of beef roasted at the same temperature to an end point of 126° F. by natural and forced convection. In that study, total cooking losses averaged 12.49 per cent for roasts cooked by natural convection and 15.22 per cent for those cooked by forced convection compared to 36.1 per cent obtained in this study. Volatile loss in the present study, 24.3 per cent, was more than twice as large as was obtained by Funk et al. (1966). In their study, volatile losses averaged 8.40 and 9.92 per cent for roasts cooked by natural and forced convection, respectively. Likewise, drip loss obtained in the present study, 11.8 per cent, was more than twice as large as was obtained in their study, 4.09 and 5.30 per cent for roasts cooked by natural and forced convection, respectively. The lower end point in the Funk et al. (1966) study undoubtedly was a factor in the lower cooking losses which they

TABLE I

COOKING LOSS AND COOKING TIME FOR BEEF SIRLOIN BUTTS ROASTED
AT TWO OVEN TEMPERATURES BY FORCED CONVECTION

Measurement	Oven Temperature		Significance of t
	200° F.	300° F.	
Volatile loss (%)	19.3	24.3	**
Drip loss (%)	6.8	11.8	***
Total loss (%)	26.1	36.1	***
Cooking time (min./lb.)	27.1	13.6	***
Total cooking time (hr.)	7.9	4.2	***

, *Significant at the 1 and 0.1% levels, respectively.

obtained for roasts cooked by forced convection than was obtained for roasts cooked at the same oven temperature in the present study.

The results of the present study do not agree with the results of several other studies in which natural convection roasting was used. Cover (1943) found no differences in either total or volatile cooking losses of bottom round roasts cooked well-done at 176° F. to 158° F. or at 257° F. to 176° F. The total cooking losses in her study, approximately 33 per cent at either oven temperature, were in fair agreement with results of the present study. However, most of the cooking losses in her study were volatile losses, 29 to 30 per cent for both oven temperatures, whereas only about two-thirds of the total cooking losses were due to volatilization in the present study (Table I, page 14).

Bramblett et al. (1959) reported that the 27.9 per cent cooking losses for beef round muscles roasted at 155° F. were higher ($P < .01$) than the 23.5 per cent for paired muscles roasted at 145° F. However, in a later study Bramblett and Vail (1964) obtained lower cooking losses for beef round muscles of U.S. Good grade roasted at 200° F., 18.80 per cent, compared to 26.01 per cent for paired muscles roasted at 155° F. to 149° F. end point ($P < .01$). The losses which they obtained at 200° F. with natural convection were considerably lower than were obtained by forced convection at 200° F. in the present study. The higher end point in the present study, 165° F., probably was a factor also in the higher losses reported here.

While Nielsen and Hall (1965) obtained a significant difference in the total cooking losses of blade roasts cooked at 225 and 325° F. to 160° F., 26.2 and 16.7 per cent, respectively, the direction of the difference was the opposite of what was obtained in the present study (Table I, page 14). However, they reported no difference in total cooking losses of rump roasts cooked under the same cooking conditions.

Data from the present study are not in agreement with those reported by Hunt et al. (1963). They found that total cooking losses were not affected by differences in oven temperature in the range from 200 to 375° F. but increased significantly as end points increased from 140, to 158, to 176° F. ($P < .01$).

Fugate (1967) reported that total cooking losses were significantly greater ($P < .01$) for standing rib roasts cooked at 325° F. than at 225° F. when the end points were 140 or 158° F. but not when the end point was 170° F. Total losses for the rib roasts cooked at 225° F. to 170° F. in her study, 24.4 per cent, were about the same as those for roasts in the present study cooked at 200° F. to 165° F. (Table I, page 14). However, the total cooking loss for sirloin roasted at 300° F. in the present study, 36.1 per cent, was considerably higher than the 25.0 per cent she obtained for rib roasts cooked at 325° F. to 170° F.

Simmers (1965) found a significant difference in total cooking losses for beef semimembranosus roasted by natural convection at 200° F. to 154° F. and at 300° F. to 158° F. The findings are not in agreement with the present study, however, since the higher loss was obtained at the lower oven temperature.

Cooking time. Total cooking time and time per pound of raw weight were significantly higher for roasts cooked at 200° F. than at 300° F. (Table I, page 14). Both total cooking time and time per pound were approximately twice as long for roasts cooked at 200° F. as at 300° F. This is in agreement with other studies on both forced convection and natural convection roasting in that longer cooking periods were required for roasting at lower oven temperatures. When paired beef round muscles were cooked by natural convection at 155 and 200° F. to an end point of 149° F., cooking time was two to four times longer for muscles cooked at 155° F. than at 200° F. (Bramblett and Vail, 1964). Simmers (1965) reported that beef semimembranosus roasts cooked by natural convection at 200° F. required approximately three hours per pound to reach an end point of 154° F., and paired roasts cooked at 300° F. to 158° F. required only fifty-four minutes per pound. Fugate (1967) found that cooking time per pound was approximately twice as long for beef ribs roasted by natural convection at 225° F. as at 325° F. when the end point was 140° F. and almost three times longer when the end point was 170° F.

Most investigators have found that forced convection cooking of meat at temperatures in the range of 250 to 350° F. resulted in shorter cooking times when compared to natural convection roasting at the same oven temperature (Borsenik and Newcomer, 1959; Schoman and Ball, 1961; and Funk et al., 1966).

In the present study approximately eight hours were required for cooking eighteen pound roasts at 200° F. by forced convection. This cooking time was much shorter than the time reported by Marshall et al. (1960) for natural convection roasting at 200° F. They found that approximately eighteen and thirty hours were required for roasting ten-pound top round roasts to 158 and 176° F., respectively.

II. EFFECT OF OVEN TEMPERATURE ON SENSORY

SCORES AND SHEAR VALUES.

Flavor, juiciness, and tenderness scores for roasts cooked at 200 and 300° F. to 165° F. were similar (Table II). Although, after removal from the oven, the temperature increased an average of 8.9° F. in roasts cooked at 300° F. and only 1.5° F. in those cooked at 200° F., roasts cooked at either oven temperature had the appearance of well-done beef and were scored good to very good for flavor, juiciness, and tenderness. Shear values also indicated that there was no difference in tenderness of roasts cooked at these two oven temperatures. This is not in agreement with some other studies in which significant differences in tenderness and other sensory properties were associated with roasting at different oven temperatures.

Cover (1943) reported that bottom round roasts cooked at 176° F. were more tender than pair-mates cooked at 257° F. Griswold (1955) found that top and bottom rounds of beef roasted to 185° F. at 250° F. scored and sheared more tender but scored less juicy

TABLE II

SENSORY SCORES AND SHEAR VALUES FOR BEEF SIRLOIN BUTTS ROASTED
AT TWO OVEN TEMPERATURES BY FORCED CONVECTION

Measurement	Oven Temperature		Significance of t
	200° F.	300° F.	
Sensory attribute ^a			
Flavor	7.7	7.5	ns ^b
Juiciness	7.2	6.9	ns
Tenderness	7.6	7.3	ns
Shear values (lb.)	19.5	21.6	ns

^aMaximum score, 9.

^bNonsignificant.

than roasts cooked at 300° F. Bramblett et al. (1959) reported that beef round muscles roasted at 145° F. were significantly juicier and more tender as indicated by panel scores and shear values than pair-mates cooked at 155° F. In a later study Bramblett and Vail (1964) found that U.S. Good grade beef round muscles cooked at 155° F. were significantly more tender as determined by shear values and panel scores but less juicy than paired muscles cooked at 200° F. Simmers (1965) reported that beef semimembranosus roasts cooked at 200° F. to 154° F. were significantly more tender but less juicy than pair-mates cooked at 300° F. to 158° F. In her study flavor of the roasts was not affected by oven temperature. Fugate (1967) found that a significant increase in tenderness was associated with the lower oven temperature when beef rib cuts were roasted at 225 and 325° F. to end points of 158 or 170° F. but not when the end point was 140° F. Flavor scores were higher and juiciness scores lower for roasts cooked at 225° F. to 170° F. than for roasts cooked at 325° F. to the same end point ($P < .01$).

Natural convection roasting was used in all of the above cited studies in which an increase in tenderness of meat was associated with lower oven temperatures. The longer cooking times required by natural convection could have promoted some solubilization of collagen as was suggested by Cover (1943). However, since there was considerable variation in cut, size of roasts, end point and oven temperature, it cannot be inferred that the type of convection was the only

factor conducive to the differences in sensory properties obtained by other workers.

III. EFFECT OF OVEN TEMPERATURE ON YIELD AND COST PER SERVING

The total yield of cooked meat was significantly greater for roasts cooked at 200° F. than at 300° F. (Table III). Also, the percentage of usable meat and number of 2.5-ounce servings per pound of meat purchased were significantly greater for roasts cooked at 200° F. This resulted in a significantly lower raw food cost per serving for roasts cooked at 200° F.

The percentage of usable meat obtained at either oven temperature was lower than the yields of usable meat reported by Lane et al. (1967). For fresh and frozen inside round of beef roasted at 300° F. by natural convection to an end point of 149° F., the yield of usable meat was 59.1 and 58.3 per cent, respectively. The higher end point of 165° F. used in the present study probably was a factor in the lower yields obtained, but this does not preclude that type of heat convection also contributed to the reduced yields.

The percentages of servable meat obtained by Funk et al. (1966) for beef loins roasted at 300° F. by either forced or natural convection also were greater than were obtained in the present study. They found no significant difference in the yield of servable meat, 65.00 per cent by natural convection and 63.22 per cent by forced

TABLE III

YIELD AND COST PER SERVING FOR BEEF SIRLOIN BUTTS ROASTED
AT TWO OVEN TEMPERATURES BY FORCED CONVECTION

Measurement	Oven Temperature		Significance of t
	200° F.	300° F.	
Total yield (%)	73.9	63.9	***
Usable meat (%)	51.3	45.7	*
Trimming loss (%)	22.6	18.2	ns ^a
Number of 2.5-ounce servings per pound purchased	3.3	2.9	*
Raw food cost per serving (¢)	20.7	23.2	**

*, **, ***Significant at the .5, 1, and 0.1% levels, respectively.

^aNonsignificant.

convection, for roasts cooked to 126° F. as compared to 45.7 per cent obtained in the present study for roasts cooked at 300° F. to 165° F.

There appeared to be some economic advantage in roasting at 200° F. rather than at 300° F. by forced convection since the increased yield reduced the raw food cost per serving. However, the cost of operating forced convection ovens at different temperatures for different lengths of time should be obtained and evaluated. The availability of the ovens for the longer cooking periods required at lower oven temperatures also should be considered.

CHAPTER V

SUMMARY

I. PURPOSE AND PROCEDURE

In this study acceptability, cooking losses, cooking time, raw food cost per serving, shear values, and yield of usable meat were compared for beef sirloin butts roasted by forced convection at 200° and 300° F.

Eight pairs of fresh U.S. Good boneless sirloin butts weighing from fourteen to twenty pounds were evaluated. One roast of each pair was cooked at 200° F. and the pair-mate at 300° F. to an end point of 165° F. in gas forced convection ovens. The gluteus medius muscle was used for sensory evaluation and for the objective measurement of tenderness by Warner-Bratzler shear. A panel of five judges scored the roasts for flavor, juiciness, and tenderness.

II. FINDINGS

Volatile, drip, and total cooking losses were lower for roasts cooked at 200° F. than at 300° F. The differences were significant for total and drip losses ($P < .001$) as well as for volatile loss ($P < .01$). Cooking time per pound was longer ($P < .001$) for roasts cooked at 200° F. The percentage of usable meat and the number of 2.5-ounce servings per pound of raw meat were greater ($P < .05$),

and the raw food cost per serving was lower ($P < .01$), for roasts cooked at 200° F. than at 300° F. No significant differences in panel scores for juiciness, flavor, and tenderness or in shear values were obtained for the roasts cooked at the two oven temperatures.

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APPENDIX

GRADING CHART FOR MEAT

Date _____

Name _____

Directions: Give full value for excellent quality.
Do not use fractional points.

Values: 9 - Excellent
8 - Very good
7 - Good
6 - Fair plus
5 - Fair
4 - Fair minus
3 - Poor
2 - Very poor
1 - Extremely poor

Sample No.			
Flavor			
Juiciness			
Tenderness			

Comments: