FACTORS AFFECTING QUALITY AND TENDERNESS IN TURKEY STEAKS

by

MARVIN HAL TAYLOR

B. S., Kansas State University, 1962

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

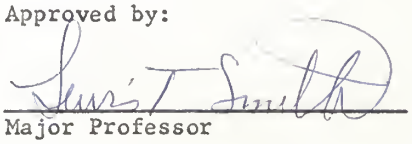
MASTER OF SCIENCE

Department of Poultry Science

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1964

Approved by:



Major Professor

TABLE OF CONTENTS

INTRODUCTION

Turkey production in the United States has grown from 35 million raised in 1939 to over 80 million in 1962 with a subsequent increase in per capita consumption to more than 7 lbs. The increase in production is due largely to more efficient practices on the part of management and the development of a larger more efficient turkey.

These large birds present a marketing problem. Small families cannot utilize economically the large portions of these birds. Institutions, although serving roast turkey over a large part of the year, need a variety of methods of serving it. The use of turkey is limited also by the time required in preparation for serving.

Boneless turkey rolls, turkey parts, and turkey steaks may prove to be the practical solution for institutions and homemakers alike. The marketing of turkey parts and turkey steaks in certain parts of the U.S.A. has proved a successful method of selling turkey in smaller quantities.

According to Branson et al. (1959), the retailing of turkey parts had gradually increased in Texas stores. Those buying turkey parts rated them favorably as to family acceptance compared with other meats such as beef, pork, fish and chicken. Retail food stores and processors over the country are increasing their interest in year round merchandising of turkey in these several forms.

Turkey steaks were first introduced in the New York area markets in November, 1947 (Smith, 1948). Since then they too have spread to other parts of the country and offer a desirable method of marketing and consuming turkey meat. Turkey steaks are marketed in various forms. Both light and dark meat steaks in patty form as well as filets are available.

Snyder and Orr (1952) reported that proper preparation of turkey steaks yielded a palatable product. There are several recommended methods of preparing turkey steaks, some of which are cross cut filets, ground turkey patties, and boneless steaks made by "knitting" pieces of turkey meat together. Goertz et al. (1949) suggested there were differences in quality and acceptability according to different methods of preparation. Turkey steaks and other artificially tenderized or ground meats have a relatively short refrigerated shelf life. This poses the problem of a need for constant cold storage.

This study was based on the need for additional information as to the best method for preparing a high quality steak. The objectives of the research were to ascertain: (1) differences in tenderness, cooking losses and percent moisture between five different methods of preparation of turkey steaks; (2) differences in tenderness, cooking losses and percent moisture of steaks with skin incorporated in the preparation of the steak and (3) differences in refrigerator shelf life between fresh and frozen steaks.

REVIEW OF LITERATURE

Since previous work with turkey steaks is limited the literature reviewed includes investigation of the evaluation of tenderness and quality of meats in particular.

Two main criteria of consumer acceptance of poultry meat are quality and tenderness. Tenderness of meat is perhaps the most important factor determining its consumer acceptability (Goodwin et al., 1961). For this reason extensive studies have been carried out to develop methods of measuring tenderness and relating it to the eating quality of meat. Although subjective

methods are generally time-consuming and often are not entirely reliable, they are the basis of reference for most present-day tenderness evaluation methods. Results from mechanical or physical methods are often related to sensory tenderness scores and have been widely used in studies of meat tenderness. Lehman in 1907 was the first to report the use of mechanical measures of meat tenderness. A mechanical device was used to determine the force required to shear meat between two cutting edges (Bailey et al., 1962).

The two most popular devices used for testing meat tenderness by present investigators are the Warner-Bratzler shear and the Allo-Kramer shear press. Burrill et al. (1962) reported high correlations between these instruments and sensory panels. Because of the difficulty of obtaining a core of meat of appropriate size, the Kramer Shear Press has proved most satisfactory for measuring tenderness of steaks (Shannon et al., 1957).

However, the problem of any instrumental or objective testing is that it must be related to human evaluation in order to determine if it is measuring attributes for which it is intended. Kramer and Twigg (1962) reported that a correlation coefficient of 0.90 or higher indicates the method or machine being used is an excellent measure of the quality factor being investigated. Similarly, a correlation of 0.80 or higher would be considered satisfactory and one that failed to reach 0.80 would be considered unsatisfactory.

Many factors have been investigated to determine their effect on tenderness (Goodwin, 1961). Dodge and Stadelman (1959) reported that age of bird, time of aging, class of poultry, temperature of the aging media, and the type of media in which the carcases are aged all appear to be important factors in postmortem tenderization. Dawson et al. (1958) and Klose et al. (1961) reported the interval between slaughter and freezing has a marked influence on the tenderness of both chicken and turkey meat.

Chemical and mechanical tenderizers, and cooking method often affect tenderness. Griswold (1962) reported that meat could be tenderized by mechanical methods that cut or break the meat fibers. These methods include pounding, scoring, cubing and grinding. Chemical preparations and some enzymes have been used successfully under certain conditions to tenderize meat. One of the most prominant and commonly used is papain.

Cooking methods have in most cases been found to be highly significant in evaluating quality and tenderness of meat; however, in studies reported by both Wheeler (1949) and Taylor (1963) cooking technique was found to have no appreciable influence on tenderness of turkey steaks. Cooking methods have been found to be highly significant in influencing the cooking and moisture losses in turkey steaks (Taylor, 1963).

Mechanically prepared turkey steaks and other mechanically tenderized meats are a highly perishable product. They must be kept frozen or under refrigerator temperatures at all times prior to cooking if quality is to be maintained. High bacterial populations cause deteriorations and spoilage. Conner et al. (1953) found first day total bacterial counts to run as high as 20,000 per gram. Most of these were psychrophilic bacteria. Sulzbacher (1950, 1952) demonstrated that certain psychrophilic bacteria were able to multiply at temperatures of 21°F. to 25°F. He emphasized the necessity of low bacterial counts on fresh meat at the time of freezing and a low storage temperature of 0°F. to -5°F. Conner et al. (1953) reported that it was desirable to use turkey steaks within a three day period of holding at refrigerator temperatures. Steaks held beyond this three day period were found to have a high bacterial population.

Another factor found to influence quality of the steaks was long freezer storage. Long storage times (over 90 - 120 days) led to dehydration, oxidation

and occurance of a rancid flavor in the turkey steaks (Conner et al., 1953, Goertz et al., 1949, and Wheeler, 1949). Wheeler (1949) reported that long time storage did not appreciately affect the tenderness of the steaks.

EXPERIMENTAL PROCEDURE

Fifty commercially processed Grade A Bronze toms, 22 - 24 pounds, from the same feed lot were obtained for this study. Birds were electrically stunned, bled, scalded at 145°F. for 30 seconds, placed in a Pickwick batch-type picker for approximately 45 seconds, eviscerated and chilled in slush ice overnight. The turkeys were packaged in polyvinylindine film, blast frozen at -35°F., and stored at 0°F. The turkeys were defrosted for 36 - 48 hours at approximately 50°F.

Steaks for all experiments were made from boneless pectoralis major muscle and the boneless thigh muscles. Fry (1963) found that over 40% of the whole turkey weight was available for steak preparation. Sixty-four tom turkeys with an average weight of 22.39 lbs. yielded 6.22 lbs. or 27.78% boneless, skinless breast meat and 2.75 lbs. or 12.28% boneless, skinless thigh meat.

Steaks were made according to the preparation procedures designated in experiments I, II and III. Each steak was individually wrapped in 1.5 mm aluminum foil, frozen and stored at approximately 0°F. in a household type upright freezer.

One method of cookery was used for experiments I and II since preliminary work had indicated that method of cookery was nonsignificant in the determination of tenderness by objective methods. The steaks were removed from the freezer, floured and cooked from the frozen state in two Sunbeam electric controlled even-heat frypans. Light meat steaks were cooked in 15 grams of

a commercial shortening per steak for 20 minutes at 300°F. Dark meat steaks were cooked for 24 min. at 300°F. in 15 grams of shortening per steak. All steaks were cooled 5 min. before objective and subjective tests were initiated.

Experiment I. Steaks from five different preparation methods (treatments) were made by the use of two machines, a meat tenderizer and a meat grinder with a hand operated patty attachment. Steaks for four of the preparation methods were made with the meat tenderizer machine and the fifth method employed the meat grinder. Ten 100-gram steaks were prepared for each treatment (one steak from each of ten different turkeys). The preparation methods were as follows:

Treatments A - D were prepared with the meat tenderizer. The treatment A meat was first run through the tenderizer with the long line of the muscle fibers against the blades and a second time with the long line of the muscle fibers with the blades.

In treatment B the meat was run through the machine with the blades cutting the long line of the muscle fibers first and then run against the long line of the muscle fibers.

Treatment C and D were similar to treatment A and B, respectively. However, the steaks were run a third time, the direction being the same as the first time through the machine.

Treatment E was made with the meat grinder and patty attachment.

Cooking losses were determined by weighing steaks to the nearest tenth of a gram before and after cooking.

Tenderness was determined by the use of an electronic recording Allo-Kramer shear press. The steaks were cooled to room temperature, and a 1-1/4 X 2-5/8 inch section was cut from the center of each steak and weighed to the

nearest tenth of a gram. The sample was placed in the Kramer cell block across all the shear blades.

A proving ring setting of 1,000 pounds was used, and the velocity of the shearing mechanism was standarized so that each downward stroke of the press was completed in 30 seconds. The shear force was recorded and then divided by the weight of the sample to obtain force per gram. This value was used as the mechanical index of tenderness for the samples tested.

Samples of meat (1/2 - inch cubes) were cut from each steak for palatability testing. These samples were evaluated by five experienced judges using a standard score card (Form 1, p. 22 Appendix). Initial tenderness, flavor, juiciness and general acceptability were scored on a 7 point scale (7, most desirable). Number of chews were also recorded as a means of estimating tenderness.

Three 2 - 4 gram samples were taken from each steak for determination of percent moisture (Par. 23.003a, A.O.A.C., 1960).

Experiment II. Steaks for two treatments were made with the grinder machine and patty attachment. The two treatments were: (1) steaks made with the skin of the bird incorporated into the meat (2) steaks made only from the boneless, skinless meat.

Two steaks with skin incorporated and two without skin were prepared from each of six different turkeys. The left half of the breast was employed in making the steaks with skin in them and the right half was used to make the skinless steaks. In the dark meat steaks the left thigh was used for the preparation of steaks with skin incorporated and the right thigh for the skinless ones.

Mechanical shear values, cooking losses and percent moisture were determined as in Experiment I. Because of the extended storage time of the turkeys

before the test was conducted, informal tasting indicated that the steaks with skin had an off flavor. This was especially true in the dark meat steaks. Therefore, formal subjective taste panel results were not obtained.

Experiment III. This experiment was designed to estimate the microbiological shelf life of frozen and fresh steaks. Twenty steaks were made from the boneless, skinless breast of two turkeys. These steaks were wrapped individually in aluminum foil as described previously and frozen overnight. The next morning 20 more steaks were made from two more turkeys and wrapped individually. Ten steaks from each of the two treatments, frozen and fresh, were placed in household type refrigerators at temperatures of 42°F. $\pm 2^{\circ}$. Total counts of bacterial populations were made daily using tryptone extract glucose agar. The plates were incubated 72 hrs. at 25°C before reading total plate counts.

EXPERIMENTAL DESIGN AND ANALYSIS

A 5 X 5 Latin square design was utilized in Experiment I (Cochran and Cox, 1957). Two trials were conducted in this experiment: one on light and one on dark meat. Taylor (1963) experienced highly significant differences in tenderness and cooking losses between the two meat types. In each trial two 5 x 5 squares were analyzed to determine shear values, cooking losses and percent moisture. The analysis of variance used for statistical analyses of objective tests is presented in Table I. Treatment x squares interaction proved to be nonsignificant and was combined with error. Least significant difference was used to distinguish differences between means.

Table 1. Analysis of variance of objective tests, Experiment I.

Source	D.F.	E.M.S.
Between squares	1	$\sigma^2 + K_1 \sigma^2_{T/S} + K_2 \sigma^2_{D/S} + K_4 \sigma^2_S$
Turkeys within squares	8	$\sigma^2 + K_3 \sigma^2_{T/S}$
Cooking times within squares	8	$\sigma^2 + K_2 \sigma^2_{D/S}$
Treatments	4	$\sigma^2 + K_1 \sigma^2_T$
Error	28	σ^2
	49	

In analyzing the subjective taste panel the results of only one square was utilized. This analysis of variance is presented in Table 2.

Table 2. Analysis of variance of taste panel results, Experiment I.

Source	D.F.	E.M.S.
Between panelists	4	$\sigma^2 + K_2 \sigma^2_P$
Between treatments	4	$\sigma^2 + K_1 \sigma^2_T$
Treatments x panelists	16	σ^2
	24	

Experiment II. In Experiment II a hierarchal classification was employed. This experiment was also conducted in two trials for light and dark meats. Each treatment was repeated 6 times and an example of the analysis of variance used is described in Table 3.

Table 3. Analysis of variance objective tests, Experiment II.

Source	D.F.	E.M.S.
Between cooking times	2	$\sigma^2 + K_1\sigma^2_{T/B/T} + K_2\sigma^2_{B/T} + K_3\sigma^2_T$
Turkeys/cooking times	3	$\sigma^2 + K_1\sigma^2_{T/B/T} + K_2\sigma^2_{B/T}$
Treatments/turkeys/cooking times	6	$\sigma^2 + K_1\sigma^2_{T/B/T}$
Steaks/treatments/turkeys/cooking times	12	σ^2
	23	

No subjective tests were conducted in this experiment.

Experiment III. Average daily total bacterial counts were recorded for frozen and fresh steaks at two refrigerator temperatures.

RESULTS AND DISCUSSION

Experiment I. Objective and subjective tests were conducted to determine the effect five different preparation methods had on cooking losses, percent moisture, tenderness and palatability of turkey steaks.

Subjective evaluations were determined on half of the samples of both light and dark meat steaks. Objective measurements were made on all the samples in the experiment. Detailed data and analyses of variance of both subjective evaluations and objective measurements were presented in appendix tables.

Shear values and cooking losses in preparaion of light meat steaks were found to differ significantly at the 1% level of probability (Table 1 - 3, Appendix). Treatment E was found to yield a significantly ($p < .01$) more tender steak with a lower cooking loss and a higher moisture retention after

cooking than the other four preparation treatments. Mean values for tenderness, cooking losses and percent moisture are presented in Table 4. Treatments A,B,C and D were found to yield similar results in shear values, cooking losses and percent moisture.

In the dark meat trials of Experiment I shear values and cooking losses were also found to be significantly different (Table 4 - 6, Appendix). Steaks prepared by method E were found to be more tender and have a lower cooking loss than all other preparation methods. Steaks prepared by treatment D were also found to be significantly lower in shear values than steaks in preparation methods A and B, but not lower than treatment C.

Table 4. Shear press, cooking losses and percent moisture, Experiment I.

Factor	LSD*	A	B	C	D	E
Shear press values						
Light	1.88	9.23	9.61	9.99	10.18	6.80
Dark	1.86	16.61	17.31	15.26	13.44	7.52
Cooking losses						
Light	2.89	29.40	28.50	29.98	29.42	24.40
Dark	3.24	42.07	41.46	39.29	39.72	33.40
Percent moisture						
Light	2.05	58.39	58.65	57.58	58.23	60.64
Dark	2.64	51.54	51.39	54.19	53.07	54.32

*LSD calculated at the 5% level.

Steaks prepared by treatment C were found to be significantly lower in shear value than B but not lower than steaks prepared by treatment A. Percent moisture determinations were significantly different in the following cases: Treatments A and B were lower than C and E but not lower than D. Steaks in treatments C, D and E were found to yield similar percent moisture determinations and thus a higher moisture retention than steaks in treatments A and B.

It was concluded that in the light meat steaks neither the direction the steaks were run through the tenderizer nor the number of times they were run through had any significant effect on the tenderness or cooking loss. The grinder method made a significantly ($p < .01$) more tender steak that had a lower cooking loss than all other preparation methods.

In the dark meat steaks the steaks run through the tenderizer three times were significantly ($p < .01$) more tender than those run through twice but not as tender ($p < .01$) as those prepared with the grinder. The dark meat steaks prepared with the grinder also had a lower cooking loss than did the ones prepared with the tenderizer.

When the taste panel results were analyzed, initial tenderness, tenderness score by chew count, juiciness, flavor and general acceptability did not differ significantly for any of the five preparation treatments. There were highly significant differences between panelists on number of chews, juiciness, flavor and general acceptability (Tables 7 - 11, Appendix). For the dark meat steaks members of the panel found a significant difference only in the tenderness and general acceptability of steaks prepared by method E (Tables 12 - 16, Appendix). In judging the dark meat, significance between panelists was found only on juiciness and flavor evaluation.

Correlation coefficients between panelists, tenderness evaluation by chew count and the Allo-Kramer shear values were relatively low, (dark meat $r = 0.683$, $p \leq .05$) and (light meat $r = 0.514$, $p \leq .05$).

Evaluation by both objective and subjective methods indicated that preparation method E tended to increase tenderness and reduce cooking losses in both light and dark meat steaks.

Experiment II. Objective tests were conducted to determine if the addition of skin to the turkey steaks would yield any differences in tenderness, cooking losses or percent moisture. All steaks were made with the grinder and patty attachment (treatment E, Experiment I).

In the light meat trial of this experiment steaks with skin were found to be only slightly more tender than those without skin. Cooking losses were found to be significantly ($p < .05$) lower in the steaks with the skin than in the ones without skin (Tables 17 - 22, Appendix). Percent moisture did not differ significantly.

Dark meat steaks were not significantly different at the 5% level of probability in shear values, percent cooking loss and percent moisture loss determinations (Table 5).

It was concluded that turkey skin could be utilized in the preparation of turkey steaks without lowering the quality or tenderness. In the case of the light meat steaks the addition of skin slightly lowered the cooking losses.

Experiment III. Steaks were examined bacteriologically each day for a period of 7 days. From the results it was evident that the shelf life of turkey steaks is quite limited. Total bacterial counts in the frozen steaks had increased to a point that an off odor was noted by the fifth day of storage. Increases in the fresh steaks were apparent from the first day on. An off

Table 5. Shear press values, cooking losses and percent moisture for Experiment II.

Factor	Means Steaks without skin	Means Steaks with skin
Shear press values		
Light	7.42	6.94
Dark	7.05	6.91
Cooking losses		
Light	28.80	27.70
Dark	39.80	42.50
Percent moisture		
Light	58.80	56.40
Dark	48.10	42.10

odor was noted by the fourth day of storage of the fresh steaks. The lag in the increases of numbers in the frozen steaks was due to time required for defrosting. Total counts of steaks held at both refrigerator temperatures were similar, although at the 35°F. temperature counts were somewhat lower. The average daily counts are presented in Table 6.

Table 6. Average daily bacterial counts on fresh and frozen steaks held at 35°F. ±2 and 42°F. ±2 (reported in thousands per gram).

Day	Fresh		Frozen	
	35°	42°	35°	42°
0	3.5	3.5	3.5	3.5
1	28.0	31.0	4.5	6.8
2	57.0	66.0	8.0	11.5
3	206.0	232.0	14.0	18.0
4	280.0	287.0	141.0	152.0
5	998.0	1,100.0	430.0	500.0
6	3,800.0	3,900.0	2,600.0	3,000.0
7	> 6,000.0	> 6,000.0	> 6,000.0	> 6,000.0

Results presented in Table 6 indicate that it is desirable to use turkey steaks within a three day period of holding under household refrigeration temperatures. These results suggest that it may be advisable to cook turkey steaks from the frozen state.

SUMMARY

Method of preparation on tenderness, cooking losses, percent moisture and palatability of machine prepared turkey steaks was studied. The study was conducted in three experiments. Experiment I was designed to determine if there was one method of preparing turkey steaks that would yield a better more tender and desirable product. Experiment I consisted of five preparation treatments, A, B, C, D, and E. Treatments A-D were prepared with a meat tenderizer machine. Treatments A and B were run through the tenderizer two times and treatments C and D were run three times. Treatment E was prepared with a grinder machine and a patty attachment. Experiment II was designed to see if the skin of the turkey could be utilized in steak preparation and its effect on tenderness, cooking losses and percent moisture. Experiment III estimated the number of days turkey steaks could be held under refrigeration before bacterial populations became excessive.

Experiment I conclusions were: (1) Turkey steaks prepared with a grinder machine with a patty attachment (preparation treatment E) were more tender, resulted in a lower cooking loss, and a higher percentage of moisture retention after cooking. (2) Analysis of quality and tenderness by sensory taste panel was nonsignificant. (3) Correlation coefficients between panelists' tenderness evaluation by chew count score and the Allo-Kramer shear value determination were relatively low.

In Experiment II the light meat steaks with skin incorporated in them were only slightly more tender but resulted in a lower cooking loss ($p < .05$) than steaks prepared without skin. The dark meat steaks were found to be similar in shear values, in cooking losses and percent moisture. It was concluded that the addition of the turkey skin to the turkey steak did not lower the quality or reduce the tenderness of the steak.

In the shelf life study of Experiment III, total bacterial counts were found to be excessive after three days at refrigerator temperatures. It therefore was concluded that turkey steaks should be consumed within this three day holding period or perhaps even cooked from the frozen state.

ACKNOWLEDGMENT

The author wishes to express his gratitude to Dr. Jack L. Fry and Dr. Lewis T. Smith of the Department of Poultry Science, for their guidance, encouragement, and constructive criticism throughout the experiment and in preparation of this manuscript. The author also wishes to thank Professor T.B. Avery, Head, Department of Poultry Science for his faith and encouragement in this area of research, Dr. Gary F. Krause for his advice on Statistical design and analyses, and panel members for their help in evaluation of the products.

REFERENCES

A.O.A.C., 1960. Methods of analysis. 9th ed. Association of Official Agricultural Chemists, Washington, D.C.

Bailey, M.E., H.B. Hedrick, F.C. Pasrish, and H.D. Naumann. 1962. L.E.E. - Kramer Shear Force as a tenderness measurement of beef steak. Food Technol. 16(12): 99.

Branson, R.E., G.J. Mountney and H.V. Courdenay, 1959. Retailing turkey parts. Texas Agri. Exp. Sta. Publication 359.

Bratzler, L.J., 1932. Measuring the tenderness of meat by means of a mechanical shear. Master's Thesis, Kansas State College, Manhattan, Kansas. 39 pp.

Burrill, L.M., D. Deelhardt, and R.L. Saffle, 1962. Two mechanical devices compared with taste panel evaluation for measuring tenderness. Food Technol. 16(10): 145-146.

Cochran, W.G. and C.M. Cox, 1957. Experimental designs. 2nd ed. John Wiley Inc. New York.

Conner, J.W., E.S. Snyder, D. MacDougall and H.L. Orr, 1953. Experiments with the preparation and storage of turkey steaks. Poultry Sci. 22: 208-216.

Dawson, L.E., J.A. Davidson, M. Frong and S. Walters, 1958. The effects of time interval between slaughter and freezing on toughness of fryers. Poultry Sci. 37: 231-235.

Dodge, J.W. and W.J. Stadelman, 1959. Postmortem aging of poultry meat and its effect on the tenderness of the breast muscle. Food Technol. 13: 81-84.

Fry, Jack L., 1963. Percentage parts yield on cut up tom turkeys. Unpublished data. Kansas State University, Manhattan.

Goertz, Grayce E., Gwendolyn L. Tinklin, and Gladys E. Vail, 1949. Practicality of frozen turkey filets, steaks, and other products. Journal of the American Dietetic Association. 25(10): 862-865.

Goodwin, T.L., W.C. Mickelberry and W.J. Stadelman, 1962. The effects of freezing, methods of cooking, and storage time on the tenderness of precooked and raw turkey meat. Poultry Sci. 41: 1268-1271.

Griswold, Ruth M., 1962. The experimental study of foods. Houghton Mifflin Company, New York, New York. pp. 526-530.

Home and Garden Bulletin No. 45. U.S.D.A., 1961. Turkey on the table the year round. Human Nutrition Research Division and Animal Husbandry Research Division, Agricultural Research Service, and Poultry Division, Agricultural Marketing Service, Washington, D.C. p. 15.

Klose, A.A., A.A. Cambell, H.L. Hanson and H. Lineweaver, 1961. Effect of duration and type of chilling and thawing on tenderness of frozen tur keys. Poultry Sci. 40: 683-689.

Kramer, A. and Bernard A. Twigg, 1962. Fundamentals of quality control for the food industry. AVI Publishing Company Inc. Westport, Connecticut.

Shannon, W.G., W.W. Marion, and W.J. Stadelman, 1957. Effect of temperature and time of scalding on the tenderness of breast meat of chicken. Food Technol. 11(5): 284-285.

Smith, Fred, 1948. Turkey for Truman becomes tradition. Turkey World 23: 16-17.

Snedecor, George W., 1956. Statistical methods. Iowa State University Press, Ames. pp. 10, 237.

Snyder, E.S. and H.C. Orr, 1952. Modern Methods of Marketing Turkey. Circular 138. Ontario Agriculture College, Guelph, Canada. p. 9.

Sulzbacher, W.L., 1952. Effect of freezing and thawing on the growth of bacteria in ground meat. Food Technol. 6: 341.

Taylor, M. Hal, 1963. The effect method of cooking has on quality and tenderness in machine knit turkey steaks. Unpublished data. Kansas State University, Manhattan.

Wheeler, Evelyn S., 1949. Factors affecting the storage life of frozen turkey steaks and filets. M.S. thesis. Kansas State College library, Manhattan.

APPENDIX

EXPLANATION OF TERMS AND ABBREVIATIONS FOR APPENDIX TABLES

Experiment I.

TK_1 - turkey designated as turkey number one, etc.

A,B,C,D,E - designate treatments A - E.

Treatment A and B - prepared with a mechnical meat tenderizer, the meat was run through the machine 2 times.

Treatment C and D - prepared with a mechnical meat tenderizer, the meat was run through the machine 2 times.

Treatment E - prepared with meat grinder and patty attachment.

Light meat steaks - steaks from pectoralis major muscle.

Dark meat steaks - steaks from boneless thigh muscles.

Shear values - actual shear value as measured by Allo-Kramer Shear press.

Cooking loss (%) - percentage of weight lost due to cooking.

Percent moisture - percentage of weight lost due to drying (A.O.A.C. 1960).

Scoring range for initial tenderness 1 - 7 (7, very tender).

Scoring range for flavor, juiciness, general acceptability 1 - 7 (7, very desirable).

Scoring tenderness by panelist chew count - determined by the number of chews required to throughly masticate a sample sufficient for swallowing.

Experiment II.

TK_1 - turkey designated as turkey number one, etc.

(T_1) - treatment 1, steaks made without skin.

(T_2) - treatment 2, steaks made with skin.

Significance of F values for analyses of variance.

* - significant at 5% level of probability.

** - significant at 1% level of probability.

Light ▱

Dark ▱

Judge _____

Date _____

SCORE CARD FOR TURKEY

Sample Number	Tenderness		Flavor	Juiciness	General Acceptability	Comments
	Initial	Number of Chews				
1.						
2.						
3.						
4.						
5.						

Descriptive Terms for Scoring Flavor, Juiciness and General Acceptability.

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

Descriptive Terms for Scoring Tenderness

7. Very tender
6. Tender
5. Moderately tender
4. Slightly tender
3. Slightly tough
2. Tough
1. Very tough

Table 1. Shear values for light meat steaks, Experiment I.

Square 1

Cooking times	TK_6	TK_7	TK_3	TK_8	TK_{10}
1	E 7.21	A 6.86	C 12.04	D 8.25	B 10.42
2	B 14.38	E 6.34	D 10.99	A 6.94	C 11.58
3	A 7.46	D 11.45	B 8.54	C 8.10	E 7.91
4	C 10.56	B 11.32	A 11.57	E 7.85	D 9.41
5	D 6.64	C 8.06	E 5.71	B 6.08	A 6.45

Square 2

Cooking times	TK_1	TK_9	TK_4	TK_2	TK_5
1	E 5.35	C 11.11	D 15.30	A 11.02	B 8.67
2	C 13.07	B 8.59	E 7.42	D 7.58	A 7.89
3	D 12.94	E 8.29	A 12.94	B 9.14	C 11.72
4	B 10.51	A 6.98	C 6.88	E 6.65	D 12.14
5	A 12.12	D 7.10	B 8.48	C 6.76	E 5.30

Analysis of variance of shear values for Experiment I (light meat).

Source	D.F.	M.S.	"F"
Between squares	1	2.81	.66
Turkeys/squares	8	5.04	1.18
Cooking times/squares	8	9.08	2.13
Treatments	4	18.95	4.45**
Error	28	4.26	

** Significant at $P < .01$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 2. Cooking loss (%) for light meat steaks, Experiment I.

Square 1

Cooking times	TK_6	TK_7	TK_3	TK_8	TK_{10}
1	E 16.9	A 25.0	C 30.3	D 23.4	B 23.8
2	B 28.7	E 20.8	D 26.2	A 32.4	C 28.4
3	A 24.3	D 33.4	B 33.0	C 26.4	E 25.7
4	C 30.6	B 27.2	A 30.9	E 29.1	D 31.4
5	D 19.4	C 28.4	E 25.0	B 23.6	A 34.1

Square 2

Cooking times	TK_1	TK_9	TK_4	TK_2	TK_5
1	E 27.2	C 29.8	D 30.2	A 25.7	B 34.2
2	C 31.8	B 30.8	E 25.2	D 29.0	A 34.7
3	D 33.4	E 24.2	A 30.9	B 31.3	C 36.9
4	B 31.5	A 29.9	C 28.7	E 26.0	D 41.2
5	A 26.1	D 26.6	B 20.9	C 28.5	E 23.9

Analysis of variance of cooking loss (%) for Experiment I (light meat).

Source	D.F.	M.S.	"F"
Between squares	1	72.48	7.33*
Turkeys/squares	8	29.50	2.98
Cooking times/squares	8	29.62	2.99
Treatments	4	51.32	5.19**
Error	28	9.98	

* Significant at $P < .05$.

** Significant at $P < .01$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 3. Percent moisture for light meat steaks, Experiment I.

Square 1

Cooking times	TK_6	TK_7	TK_3	TK_8	TK_{10}
1	E 61.1	A 58.9	C 56.2	D 61.4	B 60.8
2	B 59.5	E 63.9	D 63.1	A 59.2	C 60.4
3	A 62.5	D 57.2	B 59.5	C 61.1	E 62.7
4	C 60.2	B 60.8	A 59.6	E 62.2	D 58.3
5	D 62.7	C 60.1	E 62.6	B 62.2	A 57.9

Square 2

Cooking times	TK_1	TK_9	TK_4	TK_2	TK_5
1	E 55.8	C 53.4	D 53.7	A 60.5	B 56.9
2	C 57.2	B 54.2	E 59.5	D 59.1	A 55.0
3	D 57.3	E 61.0	A 53.8	B 59.2	C 56.4
4	B 57.9	A 56.7	C 56.6	E 57.5	D 52.2
5	A 59.8	D 57.3	B 55.5	C 54.2	E 60.1

Analysis of variance of percent moisture for Experiment I (light meat).

Source	D.F.	M.S.	"F"
Between squares	1	174.10	34.75**
Turkeys/squares	8	3.27	.65
Cooking times/squares	8	1.90	.37
Treatments	4	13.35	2.66
Error	28	5.01	

** Significant at $P < .01$

See p. 21 for explanation of terms and abbreviations used in this table.

Table 4. Shear values for dark meat steaks, Experiment I.

Square 1

Cooking times	TK_6	TK_7	TK_3	TK_8	TK_{10}
1	E 17.77	A 16.38	C 16.49	D 22.11	B 8.61
2	B 9.94	E 16.49	D 13.68	A 12.28	C 18.67
3	A 15.85	D 10.92	B 12.86	C 6.42	E 14.29
4	C 15.59	B 6.45	A 12.42	E 14.97	D 13.66
5	D 18.71	C 18.66	E 7.99	B 18.06	A 15.00

Square 2

Cooking times	TK_1	TK_9	TK_4	TK_2	TK_5
1	E 16.43	C 11.48	D 19.23	A 14.90	B 7.14
2	C 8.39	B 17.52	E 17.20	D 19.84	A 12.30
3	D 11.70	E 12.77	A 7.23	B 18.21	C 18.44
4	B 15.70	A 20.38	C 12.15	E 5.74	D 16.12
5	A 15.74	D 7.29	B 15.23	C 14.62	E 11.48

Analysis of variance of shear values for Experiment I (dark meat).

Source	D.F.	M.S.	"F"
Between squares	1	.99	.02
Turkeys/squares	8	9.99	2.71
Cooking times/squares	8	3.81	.92
Treatments	4	154.35	37.10**
Error	28	4.16	

** Significant at $P < .01$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 5. Cooking loss (%) for dark meat steaks, Experiment I.

Square 1

Cooking times	TK_6	TK_7	TK_3	TK_8	TK_{10}
1	E 35.3	A 41.9	C 38.7	D 44.3	B 38.4
2	B 35.4	E 39.4	D 42.2	A 36.5	C 43.9
3	A 33.7	D 32.1	B 40.8	C 34.2	E 45.7
4	C 37.2	B 34.5	A 39.9	E 41.7	D 38.3
5	D 41.0	C 48.8	E 31.8	B 37.8	A 40.9

Square 2

Cooking times	TK_1	TK_9	TK_4	TK_2	TK_5
1	E 39.5	C 39.4	D 40.2	A 37.9	B 30.0
2	C 37.0	B 44.3	E 42.2	D 44.3	A 38.4
3	D 38.4	E 41.4	A 35.0	B 43.3	C 43.3
4	B 41.2	A 44.8	C 39.7	E 26.6	D 42.0
5	A 37.2	D 31.1	B 41.5	C 44.0	E 42.3

Analysis of variance for cooking loss (%) Experiment I (dark meat).

Source	D.F.	M.S.	"F"
Between squares	1	2.24	.02
Turkeys/squares	8	8.57	.07
Cooking times/squares	8	8.57	.07
Treatments	4	118.16	9.45**
Error	28	12.50	

** Significant at $P < .01$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 6. Percent moisture for dark meat steaks, Experiment I.

Square 1

Cooking times	TK_6	TK_7	TK_3	TK_8	TK_{10}
1	E 57.7	A 56.7	C 50.6	D 49.8	B 52.6
2	B 56.0	E 58.5	D 54.6	A 54.4	C 48.9
3	A 53.9	D 55.0	B 54.1	C 57.7	E 45.7
4	C 56.9	B 52.8	A 51.9	E 52.4	D 56.3
5	D 49.5	C 47.0	E 49.5	B 54.0	A 48.4

Square 2

Cooking times	TK_1	TK_9	TK_4	TK_2	TK_5
1	E 51.9	C 48.8	D 49.8	A 56.3	B 52.7
2	C 51.9	B 48.6	E 55.7	D 49.7	A 55.2
3	D 53.2	E 52.1	A 53.2	B 56.3	C 51.2
4	B 56.5	A 53.0	C 51.7	E 61.1	D 51.6
5	A 51.7	D 55.7	B 53.0	C 51.3	E 48.0

Analysis of variance of percent moisture for Experiment I (dark meat).

Source	D.F.	M.S.	"F"
Between squares	1	.44	.05
Turkeys/squares	8	12.13	1.45
Cooking times/squares	8	12.88	1.54
Treatments	4	19.60	2.34
Error	28	8.35	

See p. 21 for explanation of terms and abbreviations used in this table.

Table 7. Average scores for initial tenderness, taste panel, light meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	6.2	6.0	5.0	5.4	6.0
2	6.2	6.6	6.2	6.0	6.8
3	6.4	6.2	6.4	6.2	6.2
4	6.0	6.0	6.0	5.4	6.0
5	6.0	6.0	6.0	6.0	6.0

Analysis of variance of initial tenderness for Experiment I (light meat).

Source	D.F.	M.S.	"F"
Between panelists	4	.375	2.38
Between treatments	4	.157	2.31
Treatments x panelists	16	.068	

See p. 21 for explanation of terms and abbreviations used in this table.

Table 8. Average number of chews, taste panel, light meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	26.0	24.6	30.2	25.2	26.4
2	38.4	34.8	39.0	40.2	34.4
3	22.4	22.2	21.6	22.2	21.6
4	23.2	26.8	20.8	25.4	20.2
5	24.8	23.4	23.4	24.6	24.6

Analysis of variance of tenderness based on number of chews for Experiment I (light meat).

Source	D.F.	M.S.	"F"
Between panelists	4	192.39	61.27**
Between treatments	4	3.14	.73
Treatments x panelists	16	4.31	

** Significant at $P < .01$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 9. Average scores for juiciness, taste panel, light meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	6.0	6.2	5.0	5.2	5.8
2	2.2	2.2	2.6	2.4	2.8
3	4.8	5.2	4.8	5.2	4.8
4	5.4	5.4	5.4	5.4	5.4
5	5.4	5.4	5.6	5.8	5.4

Analysis of variance of juiciness for Experiment I (light meat).

Source	D.F.	M.S.	"F"
Between panelists	4	8.97	299.16**
Between treatments	4	.03	.31
Treatments x panelists	16	.10	

** Significant at $P < .01$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 10. Average scores for flavor, taste panel, light meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	6.4	6.8	5.6	6.0	6.0
2	5.0	4.8	4.8	4.8	5.0
3	6.6	6.4	5.8	6.4	5.8
4	4.8	5.4	5.4	5.4	5.2
5	6.0	6.0	6.2	6.4	6.0

Analysis of variance for flavor score, Experiment I (light meat).

Source	D.F.	M.S.	"F"
Between panelists	4	1.90	20.40**
Between treatments	4	.09	1.01
Treatments x panelists	16	.09	

** Significant at $P < .01$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 11. Average scores for preference and general acceptability, taste panel, light meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	6.4	6.4	5.4	5.8	6.0
2	5.0	4.8	5.0	4.8	5.2
3	6.2	6.2	5.8	6.2	6.0
4	4.8	5.6	5.4	5.4	5.4
5	6.0	6.0	6.0	6.0	6.0

Analysis of variance for preference and general acceptability for Experiment I.(light meat).

Source	D.F.	M.S.	"F"
Between panelists	4	1.27	23.87**
Between treatments	4	.05	.70
Treatments x panelists	16	.07	

** Significant at $P < .01$

See p. 21 for explanation of terms and abbreviations used in this table.

Table 12. Average scores for initial tenderness, taste panel, dark meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	4.6	5.4	4.6	5.0	7.0
2	4.0	4.4	5.0	5.0	6.8
3	6.0	5.8	6.2	6.0	6.8
4	6.0	5.0	5.5	5.8	6.5
5	5.6	5.0	5.4	5.6	6.0

Analysis of variance of initial tenderness for Experiment I (dark meat).

Source	D.F.	M.S.	"F"
Between panelists	4	.91	.49
Between treatments	4	1.84	8.26*
Treatments x panelists	16	.22	

* Significant at $P < .05$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 13. Average scores for tenderness chews, taste panel, dark meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	28.0	25.4	26.2	24.4	18.6
2	34.6	38.0	37.6	38.6	29.6
3	23.0	27.8	21.0	25.2	17.8
4	23.0	31.3	26.8	23.3	17.5
5	29.6	37.4	33.2	30.2	26.6

Analysis of variance of tenderness based on number of chews for Experiment I (dark meat).

Source	D.F.	M.S.	"F"
Between panelists	4	151.17	2.30
Between treatments	4	65.58	14.24**
Treatments x panelists	16	4.61	

** Significant at $P < .01$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 14. Average scores for juiciness, taste panel, dark meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	5.0	5.2	5.0	5.2	6.8
2	3.2	3.2	2.8	2.8	4.2
3	5.0	5.2	5.0	5.4	5.6
4	5.2	5.2	5.2	5.5	5.2
5	5.2	5.5	5.4	5.4	5.4

Analysis of variance of juiciness for Experiment I (dark meat).

Source	D.F.	M.S.	"F"
Between panelists	4	4.22	9.04*
Between treatments	4	.47	2.57
Treatments x panelists	16	.18	

* Significant at $P < .05$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 15. Average scores for flavor, taste panel, dark meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	5.4	5.6	5.0	5.2	6.6
2	4.6	3.4	4.0	4.8	5.2
3	6.4	5.8	6.6	6.6	6.8
4	5.2	5.2	5.2	5.2	5.2
5	6.2	6.0	5.8	5.8	6.0

Analysis of variance of flavor scores for Experiment I (dark meat).

Source	D.F.	M.S.	"F"
Between panelists	4	2.99	7.10*
Between treatments	4	.42	2.62
Treatments x panelists	16	.16	

* Significant at $P < .05$.

See page 21 for explanation of terms and abbreviations used in this table.

Table 16. Average scores for preference and general acceptability, taste panel, dark meat, Experiment I.

Panel members	Treatments A	B	C	D	E
1	4.8	5.6	5.2	5.2	6.8
2	4.8	4.2	4.6	4.8	5.8
3	6.1	5.5	6.1	6.1	6.5
4	5.2	5.2	5.2	5.2	5.5
5	5.8	5.5	5.6	5.5	5.8

Analysis of variance for preference and general acceptability for Experiment I (dark meat).

Source	D.F.	M.S.	"F"
Between panelists	4	.917	1.49
Between treatments	4	.615	4.07*
Treatments x panelists	16	.151	

* Significant at $P < .05$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 17. Shear values of light meat for Experiment II.

Cooking time 1				Cooking time 2				Cooking time 3			
TK_1		TK_2		TK_3		TK_4		TK_5		TK_6	
(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)
5.03	4.62	6.94	7.71	9.59	7.24	13.03	9.06	6.21	7.74	5.44	7.27
5.15	4.94	7.96	5.53	8.18	8.87	9.57	6.89	6.71	7.27	5.26	6.13

Analysis of variance of shear values.

Source	D.F.	M.S.	"F"
Between cooking times	2	21.59	4.84
Turkeys/cooking times	3	4.46	1.73
Treatments/turkeys/cooking times	6	2.58	2.13
Steaks/treatments/turkeys/cooking times	12	1.21	

See p. 21 for explanation of terms and abbreviations used in this table.

Table 18. Cooking loss values (%) of light meat for Experiment II.

Cooking time 1				Cooking time 2				Cooking time 3			
TK_1		TK_2		TK_3		TK_4		TK_5		TK_6	
(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)
21.2	24.0	28.9	22.1	29.1	31.5	29.4	30.5	27.2	30.1	28.9	29.1
23.9	26.8	34.6	18.9	26.0	29.5	35.5	29.1	30.1	29.7	31.2	30.9

Analysis of variance of cooking loss (%).

Source	D.F.	M.S.	"F"
Between cooking times	2	62.12	9.710*
Turkeys/cooking times	3	6.40	.253
Treatments/turkeys/cooking times	6	25.33	4.760*
Steaks/treatments/turkeys/cooking times	12	5.32	

* Significant at $P < .05$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 19. Percent moisture of light meat for Experiment II.

Cooking time 1				Cooking time 2				Cooking time 3			
TK_1		TK_2		TK_3		TK_4		TK_5		TK_6	
(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)
64.6	58.7	58.8	61.2	55.4	56.3	58.6	51.9	59.7	55.7	57.9	55.4
62.1	56.8	57.1	59.4	59.5	52.1	54.4	57.7	58.3	56.4	59.6	55.1

Analysis of variance of percent moisture.

Source	D.F.	M.S.	"F"
Between cooking times	2	34.36	22.03**
Turkeys/cooking times	3	1.56	.013
Treatments/turkeys/cooking times	6	11.88	2.66
Steaks/treatments/turkeys/cooking times	12	4.46	

** Significant at P .01.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 20. Shear values of dark meat for Experiment II.

Cooking time 1				Cooking time 2				Cooking time 3			
TK_1		TK_2		TK_3		TK_4		TK_5		TK_6	
(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)
6.17	4.21	4.79	7.53	5.99	8.33	10.19	8.00	5.69	5.17	9.79	9.54
6.62	7.86	5.25	6.49	6.94	5.72	8.01	7.86	5.76	4.29	9.42	7.91

Analysis of variance of shear values.

Source	D.F.	M.S.	"F"
Between cooking times	2	4.86	.39
Turkeys/cooking times	3	12.45	9.88**
Treatments/turkeys/cooking times	6	1.26	.98
Steaks/treatments/turkeys/cooking times	12	1.29	

** Significant at $P < .01$.

See p. 21 for explanation of terms and abbreviations used in this table.

Table 21. Cooking loss values (%) of dark meat for Experiment II.

Cooking time 1				Cooking time 2				Cooking time 3			
TK_1		TK_2		TK_3		TK_4		TK_5		TK_6	
(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)
37.9	46.9	37.7	39.7	36.7	41.2	31.9	46.9	55.6	40.3	39.0	43.3
44.1	42.9	39.9	42.9	34.8	38.0	38.3	45.2	39.9	38.2	41.5	44.2

Analysis of variance of cooking loss (%).

Source	D.F.	M.S.	"F"
Between cooking times	2	27.13	2.13
Turkeys/cooking times	3	12.71	.317
Treatments/turkeys/cooking times	6	40.11	2.50
Steaks/treatments/turkeys/cooking times	12	16.05	

See p. 21 for explanation of terms and abbreviations used in this table.

Table 22. Percent moisture of dark meat for Experiment II.

Cooking time 1				Cooking time 2				Cooking time 3			
TK_1		TK_2		TK_3		TK_4		TK_5		TK_6	
(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)	(T_1)	(T_2)
50.6	41.6	49.1	49.5	46.9	41.6	45.7	39.3	50.3	45.6	51.4	43.8
49.0	37.5	41.3	39.7	51.4	43.5	46.4	33.9	48.1	51.1	46.8	37.6

Analysis of variance of percent moisture.

Source	D.F.	M.S.	"F"
Between cooking times	2	21.61	.91
Turkeys/cooking times	3	23.70	.46
Treatments/turkeys/cooking times	6	51.60	3.82
Steaks/treatments/turkeys/cooking times	12	13.52	

See p. 21 for explanation of terms and abbreviations used in this table.

FACTORS AFFECTING QUALITY AND TENDERNESS IN TURKEY STEAKS

by

MARVIN HAL TAYLOR

B. S., Kansas State University, 1962

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Poultry Science

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1964

Method of preparation on tenderness, cooking losses, percent moisture and palatability of machine prepared turkey steaks was studied. The study was conducted in three experiments. Experiment I was designed to determine if there was one method of preparing turkey steaks that would yield a better, more tender and desirable product. Experiment I consisted of five preparation treatments, A,B,C,D, and E. Treatments A-D were prepared with a meat tenderizer machine. Treatments A and B were run through the tenderizer two times and treatments C and D were run three times. Treatment E was prepared with a grinder machine and a patty attachment. Experiment II was designed to see if the skin of the turkey could be utilized in steak preparation and its effect on tenderness, cooking losses and percent moisture. Experiment III estimated the number of days turkey steaks could be held under refrigeration before bacterial populations became excessive.

Experiment I conclusions were: (1) Turkey steaks prepared with a grinder machine with a patty attachment (preparation treatment E) were more tender, resulted in a lower cooking loss, and a higher percentage of moisture retention after cooking; (2) Analysis of quality and tenderness by sensory taste panel was nonsignificant; (3) Correlation coefficients between panelists' tenderness evaluation by chew count score and the Allo-Kramer shear value determination were relatively low.

In Experiment II the light meat steaks with skin incorporated in them were only slightly more tender but resulted in a lower cooking loss ($P < .05$) than steaks prepared with skin. The dark meat steaks were found to be similar in shear values, and in cooking losses and percent moisture. It was concluded that the addition of the turkey skin to the turkey steak did not lower the quality or reduce the tenderness of the steak.

In the shelf life study of Experiment III, total bacterial counts were found to be excessive after three days at refrigerator temperatures. It therefore was concluded that turkey steaks should be consumed within this three day holding period or perhaps even cooked from the frozen state.