YIELD AND PALATABILITY OF SIX STYLES OF MILD CURED HAMS IN THE 10 TO 12-POUND WEIGHT RANGE

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YIELD AND PALATABILITY OF SIX STYLES OF MILD CURED HAMS IN THE 10 TO 12-POUND WEIGHT RANGE

By

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INTRODUCTION

A consumer choosing hams from the many styles presently available may find it difficult to make a wise selection. Terminology used by the packer to describe the style may be confusing. In addition, information concerning the yield and palatability of the styles is not generally available to the institution purchaser.

Since 1940, most packers have processed tenderized mild-cured hams. Although investigations were conducted between 1925 and 1939 on country-style cured hams, only a few reports of data collected from tenderized mild-cured hams have appeared in the literature.

This investigation, comprising one part of a larger project, deals with the effect of ham style on cooking losses, sliceable and scrap portion, and palatability of mild-cured hams in the 10 to 12-pound weight range. In the master project these same factors are considered for all styles available in weight ranges from 8 to 22 pounds. The institution consumer may find the data helpful in selecting a style of ham suitable for his needs.

REVIEW OF LITERATURE

The Committee on Preparation Factors of the Cooperative Meat Investigations (5) in describing roasting of meats, defines a desirable product as one which has the least shrinkage or cooking loss; the greatest palatability; the lowest cost per serving; and the greatest ease of manipulation... They define palatability as the degree to which a product is acceptable, pleasing, agreeable, or satisfying to the palate, with special reference to flavor and tenderness.

Factors Affecting Palatability, Yield, and Cooking Losses

A new era in meat production studies began when investigations showed that cooking methods markedly influenced the palatability of cooked meat (5). Previously, livestock studies had ended with the dressing of the animal. Since the relationship between preparation procedures and palatability was established, production practices have been put to the "eating test" and the results regarded as an index for probable consumer acceptance.

Effect of cooking methods

The foundation for the present method of cooking hams was laid between 1925 and 1935 when hams were cured in heavy salt brine for 60-80 days. Staggs (32) aptly stated the problem of present cooking methods when she pointed out that recent developments in processing have altered the methods of preparation and the length of time for cooking hams. The available information has resulted from scientific experimentation on hams of the old type cure and may not be completely applicable to the cooking of new process hams.

Only Rowntree (28), in an attempt to establish a precise method for cooking hams experimentally, roasted and boiled hams at various temperatures. She concluded that hams could be roasted sucessfully in the oven at a temperature of 350°F for 30 minutes, then reducing the temperature to 250°F for the remaining cooking time. In addition, in the second part of her experiment, she concluded that hams roasted to an internal temperature of 70°C were thoroughly cooked.

Only Purdy (25) reported on a satisfactory method of cooking hams in water to give a standard product and the least shrinkage. The least total loss in weight was sustained by the hams started in boiling water, reduced at once to a temperature of 180°F, cooked to an interior temperature of 158°F, and left in the broth overnight. She commented that the temperature of the broth and the quality of the individual hams were the determining factors in weight loss of the hams.

Gillaspie (15) studied the influence of cooking temperatures on shrinkage of cooked hams. The hams were immersed in 180°F water and cooked at that temperature until an internal temperature of 70°C was reached. The hams were left in the liquor for 18 hours, and cooled at various temperatures. She indicated that the temperature of the liquor in which the ham is cooled affects the loss. Minimum weight loss was at 1.6°C, with an increase in weight loss reported at cooling temperatures above and below that point.

According to Staggs (32), the influence of three oven temperatures (250°, 300°, and 375°F) on cooking losses and palatability of commercially cured hams showed the following results:

An increase in cooking losses directly proportional to an increase in oven temperature

A slight increase in tenderness and flavor scores with a decrease in oven temperature

McElhinney (23) roasted hams at 300°F to an internal temperature of 70°C to determine shrinkage and waste of hams. Her results are included in the summary table (Appendix A). In 1929, Burgoin (4) collected additional data on shrinkage and carving waste of hams weighing 14 to 20-pounds. The hams were boned, roasted in a 150°C oven for 30 minutes, and finished at 125°C to an internal temperature of 70°C. According to her results, the 14 to 16-pound hams had the highest percentage of sliceable meat, and the 18 to 20-pound hams had the smallest percentage. In addition, she found that the fatter hams showed the greatest percentage of total cooking loss.

Alexander and Hankins (1) reported on the yield of cooked edible portions of 29 hams. The hams were baked in uncovered pans at 257°F to an internal temperature of 76°C. They reported a higher shrinkage percentage in two commercially-cured tenderized hams than in 18 dry-cured hams (Appendix A).

Effect of diet and cure

Fenton and co-workers (13) when adding antiobiotic and fat to the diet and phosphate to the cure of smoked hams, found no significant differences in the color of the cooked or of the uncooked meat attributable to the diets of the pigs, to the curing of the hams, or to interaction of these factors. Because the statistical differences attributable to the diets of the pigs for aroma, flavor, and "chew" scores were so small, the investigators concluded that neither the diet nor the cure resulted in appreciable differences in the qualities of the smoked hams (21).

In their investigation of four types of cured hams, Weir and Dunker (34) reported that all four types were considered good in overall desirability. Between the two short brine cured tenderized types, tendered and ready-to-eat, only intensity of fat flavor showed a significant difference out of eight characteristics judged.

Saffle (30) found no significant differences between the degree of finish of the carcass, and the taste panel scores or the cooking shrinkage of smoked tenderized hams.

Processing

At the present time, the most widely used method for processing hams commercially is the sweet pickle or vascular-pumped cure.

Curing

Jensen (19) pointed out that during the past twenty years the curing time has been shortened by pumping the curing solution into the proper artery of a cut of meat. Because the arteries furnish natural pathways for distribution of curing solutions, the time required for curing is reduced. After the pickle solution is evenly distributed under pressure, hams are placed in vats and immersed in a "cover pickle" at 36 to 38^{o}F to cure the peripheral tissues. Less salt is used in these cures than in a country-style cure. The same curing process is described by Fields and Dunker (14) in three steps: pumping, curing in cover pickle, and smoking.

Ziegler (37) described the smoking process for tenderized hams. The tenderizing procedure in the smoke house requires about 24 hours. During the first 8 hours, the smoke house is heated to 125°F. All drafts are opened to carry off excess moisture, and no smoking takes place. During the next 8-hour period, drafts are closed half way, the temperature is raised to 135°F until the internal temperature of the ham reaches 142°F for uncooked hams. To produce precooked hams, the internal temperature must be held at 155°F or above at least 2 hours.

Color development.

Many investigations concerned with the factors related to color development in cured pork products have been published. Rose and Peterson (27) reported that nitrite, added directly to the ham or formed by reduction of nitrate, is essential to good color development in the curing of pork products. However, in reporting on the problem of meat discoloration by display case lights, Ramsbottom, Galser, and Shultz (26) stated that, even in the presence of -SH groups, nitrite gives only temporary color protection under continuous lighting at an intensity frequently observed in display counters and store aisles. Watts Erdman and Wentworth (33) substantiated these conclusions.

In describing the interesting irridescent colors sometimes found in sliced ham, Jensen (18) indicated that the peculiar surfaces of the meat fibers caused this mother-of-pearl effect. The breaking up of white light by the highly fibrous character of the sliced meat surface produces the structural color. This phenomenon has no sanitary significance.

Advances in processing

One of the new developments in processing of smoked meats is the continuous system of electrostatic smoking reported by Hanley and co-workers (16). By passing through six infra-red heating chambers the meat rapidly attains an internal temperature of 120^{o}F. The meat is conveyed into an electrostatic smoking chamber and subsequently to an infra-red drying unit The entire process requires 30 minutes. This continuous system produces smoke in such a short time and at such a low temperature that no increase in bacterial population is evident.

Reports on irradiation of cured pork by Erdman and Watts (11) showed that a high dose of irradiation was necessary to effect sterilization in canned hams. Off odors were detected, ham color faded markedly and irregularly, and free -SH groups decreased both on irradiation and subsequent storage. However, the post-heated irradiated samples of ground pork containing cure showed neither bacterial spoilage nor color loss after storage of 170 days at room temperature. Ryer (29) reported a dosage of 30,000 rep necessary to kill trichina by gamma ray irradiation. At 3,000,000 rep sterilization was effected. No radioactivity was induced in foods at sterilization level. Acceptability of irradiated foods varied. Ham samples appeared to be acceptable following treatment at sterilization level and also after storage periods following such irradiation.

In his comprehensive report of advances in meat canning, Jul (20) emphasized the need for research in the field of resistance of bacteria, nutritive value, flavor, and water retention of canned hams. He stated that one of the aims of meat research should be to develop temperature resistance curves for bacteria in various meats, and to investigate their relation to the presence of nitrite and other food additives.

Terminology and Federal Regulation

The American Meat Institute was consulted to determine the types of hams generally available from commercial packers and to clarify the labeling interpretation of these types.

Terminology

In defining the kinds of ham available, the American Meat Institute (2) included the following definitions:

Cook-before-eating (uncooked or regular) hams--have been heated in compliance with government regulations, to an internal temperature of at least 137°F. These hams require thorough cooking before eating--(cooked to an internal temperature of 160°F as registered by meat thermometer).

Ready-to-eat hams-- in compliance with government regulations, have been heated to an internal temperature of

at least 137°F and then further processed to make them palatably tender. This processing makes them safe to eat, but the texture and flavor are improved by further cooking. These hams should be heated to an internal temperature of at least 130°-140°F.

Fully cooked or cooked hams-- have been processed to an internal temperature of 140°-150°F or above and may be served without further cooking; or they may be reheated before serving. Heating to an internal temperature of 125°-130°F will warm them sufficiently.

Canned hams-- are completely cooked when purchased. To reheat, bake to an internal temperature of 125°-130°F.

They also define three styles of ham available as follows:

Regular--bone in. Available as cook-before-eating, ready-to-eat, and fully cooked or cooked. May be purchased whole, cut in half, or as ham slice.

Skinless, shankless--ham has bony shank removed and it is skinned and trimmed of excess fat. Available as cook-before-eating, ready-to-eat, and fully cooked.

Boneless, skinless--Ham has been boned and shaped into rolls. Available as cook-before-eating and fully cooked.

Fields and Dunker (14) similarly describe two of the ham types in their study, referring to them as

Type I. Sweet pickle, quick-cured, tendered ham-- which has been heated to 140°F.

Type II. Sweet pickle, quick-cured, ready-to-eat hams which have been smoked to at least 155°F.

Federal regulation

Federal specifications for cured-cooked hams (35) require that the ham shall be mildly and thoroughly, but not excessively, cured. Smoked hams must be smoked continuously in a dense natural smoke for not less than 3 hours in temperatures not less than 115°F, and then promptly cooked or chilled. The ham shall be cooked with moist heat in temperatures and for the time necessary to attain an internal ham temperature of at least 150°F.

Federal specifications for cured-uncooked ham require an internal ham temperature of 137°F.

Canned hams must be cooked to an internal ham temperature of not less than 150°F (36). All cans must be labeled with the warning, "PERISHABLE, KEEP UNDER REFRIGERATION."

Bacterial Food Poisoning

Dack (6) emphasized the danger of food poisoning from rapidly cured hams. He pointed out that many packers are aware of the problem. The method of heating hams during manufacture is designed to be effective against staphylococci so that hams are safe when they leave the packers. However, keeping the hams in a warm kitchen for several hours favors the growth of staphylococci and the production of enterotoxin. In order to control the outbreaks of food poisoning from cured-meat products, educating the public and retailers to the fact that ham is perishable and must be kept under refrigeration is necessary.

Dack (6), in describing the unique qualities of staphylococci and their enterotoxin, stated that the per cent of enterotoxin in toxic material is very small (.05 to 5%). Growing in hams without producing any signs of spoilage, the staphylococci produce an enterotoxin resistant to heating and freezing and soluble in water and dilute salt solutions.

Draim (9) baked hams to an internal temperature of 180°F in a 350°F oven. She cooled the hams at various temperatures. Her results showed that the hams cooled at room temperature were in the danger zone for staphylococcus growth (70 to 115°F) three times as long as those refrigerated immediately. The hams refrigerated when the interior temperature reached 115°F were in the danger zone twice as long as those refrigerated immediately. Immediate refrigeration proved to be the most rapid method of cooling both the interior and the surface of the meats.

Jensen (19) emphasized that cooked hams must not be held for a period of more than 4 hours in the incubation temperature range. Because the time within the incubation range is accumulative, the total time within the zone should not be more than 4 hours if the product is refrigerated at intervals. McDivitt (22) in her study on boned and rolled hams, reported ham samples stored at 30°C showed rapid cell multiplication between 3 and 18 hours. Inoculated samples stored at refrigerator temperatures gave little evidence of bacterial change and were unchanged in appearance, odor, and color at the end of 14 days.

Jensen (19) stated that staphylococci grow most rapidly at temperatures between 68°F and 115°F. During a 4-hour period in foods at this temperature range, these bacteria will secrete enough harmful toxin to cause illness in persons eating the food. He emphasized the importance of cooking ham to an internal temperature of 162°F.

According to Niven and Evans (24), cured meats such as prepackaged cold cuts and bacon are rarely handled under temperature conditions that would support the growth of staphylococcus. Therefore, the problem of staphylococcus food poisoning within the meat industry limits itself largely to hams. Because of their large size, temperature adjustment and control in the ham are difficult to achieve. Also, the American consumer has not yet become accustomed to the fact that our modern cured hams are perishable. In agreement with Jensen, they (24) point out that curing salts in the concentrations added to meat ordinarily do not inhibit the growth of staphylococcus. Esselen and Levine (12), in their summary of available literature, also stressed the fact that tenderized hams is a frequent source of staphylococcus food poisoning.

Husseman and Tanner (17) emphasized that the danger of staphylococcus poisoning is not alleviated either by chilling or, in some cases, by heating food after it has been allowed to stand at room temperature.

METHOD OF PROCEDURE

The standardized procedures for this study were established by preliminary investigations preceding the initial phase of this project. The methods used in Part I of the project in which the 12 to 14-pound weight range was studied have been followed as closely as possible in this investigation.

Downs (8) states that preliminary investigations were held for the purpose of establishing the end internal temperature for roasting, developing techniques, and training the taste panel in evaluating the samples. Because instructions on ham labels varied and processing information was not available, the final internal temperature was difficult to establish. A campus bacteriologist was consulted to determine the minimum internal temperature which would insure the safety of the hams. Palatability evaluations of hams baked to various internal temperatures were also considered. As a result of these panel preferences and the bacteriological recommendations, the end internal temperature was set at 79°C for all hams.

A fraction of the toxin may be destroyed by heating at the boiling point for 30 minutes or more, but there is no reliable way of eliminating the toxin from the food.

Baughman (3) points out that staphylococcus food poisoning is a continual threat to all organizations and institutions that handle and prepare food. Investigations have shown that a toxic substance produced by certain strains of Micrococcus pyogenes var. aureus causes food poisoning. However, why some staphylococci produce enterotoxin and some do not is still unknown. In fact, relatively little is known about the properties of the toxin. Baughman's study showed that food handlers contaminate food with pathogenic staphylococci of varied reactions. The foods in his investigation were of the type that are frequently handled after cooking and before serving. He concluded that the control of this type of food poisoning lies in the education of the public, food handlers, and organizations that prepare food for large numbers of people.

Selection of Hams

Processors were contacted to determine the styles and kinds of ham readily available to the institution consumer.

Kinds of ham available

Two kinds of ham were obtained for this study. Cured hams, processed to a temperature of 137°F, are referred to as "uncooked" in this report. However, various labels read, "ready-to-eat," "cook-before-eating," "certified,", or "smoked." Hams referred to as "precooked" in this study were processed to a minimum temperature of 150°F according to Federal specifications. Labels for such hams read "ready-to-eat," "fully cooked," or "cooked."

Styles selected

Six styles of hams in the 10 to 12-pound range were readily available to the institution buyer. Four of these styles were available both as uncooked and precooked. The two shapes of canned hams were available as precooked. Ten hams of each style were baked. A description of the styles selected and the code letter follows:

Regular bone-in: uncooked (A_1) and precooked (A_2). This style of whole ham contains the aitch, femur, and shank bones. All skin except a collar of shank skin is removed. (Figure 1)

Skinless and shankless: uncooked (B_1) and precooked (B_2). The shank bone is removed, and the ham is packaged without skin. (Figure 2)

Boned, rolled, and tied: uncooked (D_1) and precooked (D_2). The whole ham, commonly referred to as BRT, is boned and shaped into rolls. A visking wrapper with a metal plate at each end retains the cylindrical shape of the roll. (Figure 4)

Splits: uncooked (F_1) and precooked (F_2). Boneless pieces from one or more hams are shaped together into a roll. A visking wrapper with metal plate at each end retains the cyclindrical shape of the ham. (Figure 6)

Canned hams: pear shaped (C) and pullman (E). The boned and trimmed hams or ham pieces are packed into cans. Gelatin is added to replace the air and retain the shape, and the ham is processed. (Figures 3 and 5)

Preparation and Baking of Hams

Preparation procedures for baking the hams were selected to parallel those of a quantity food service.

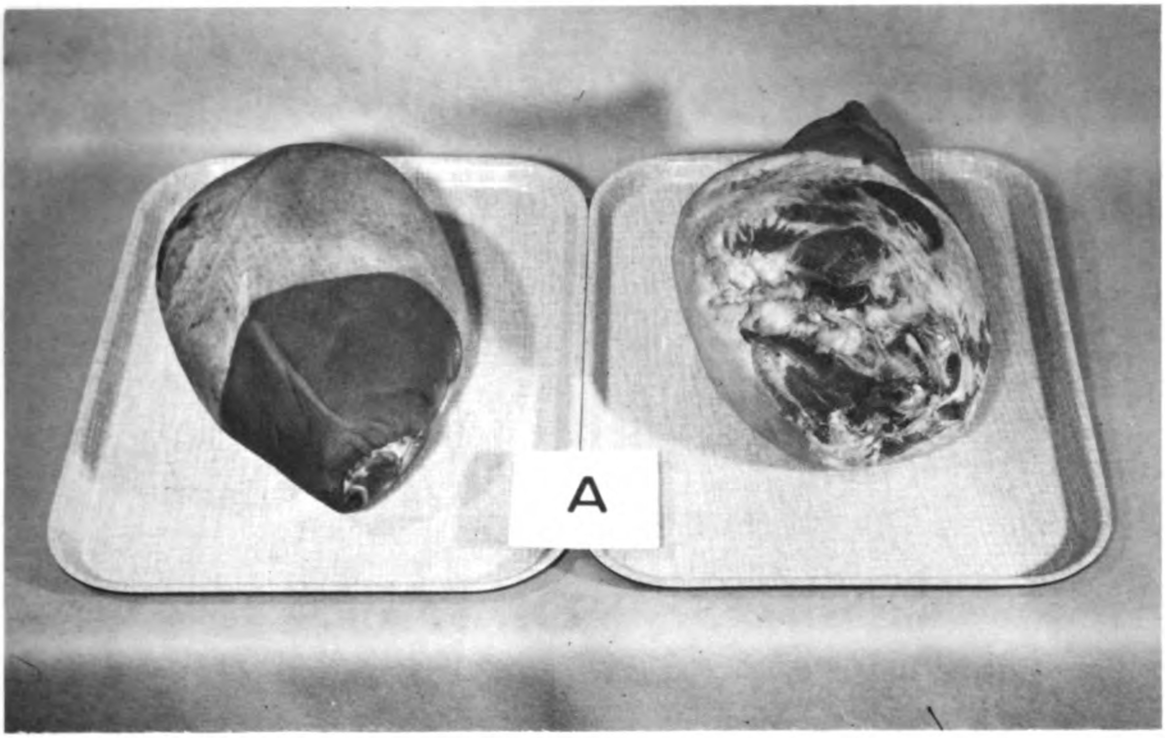

Figure 1. Regular bone-in style, uncooked and precooked

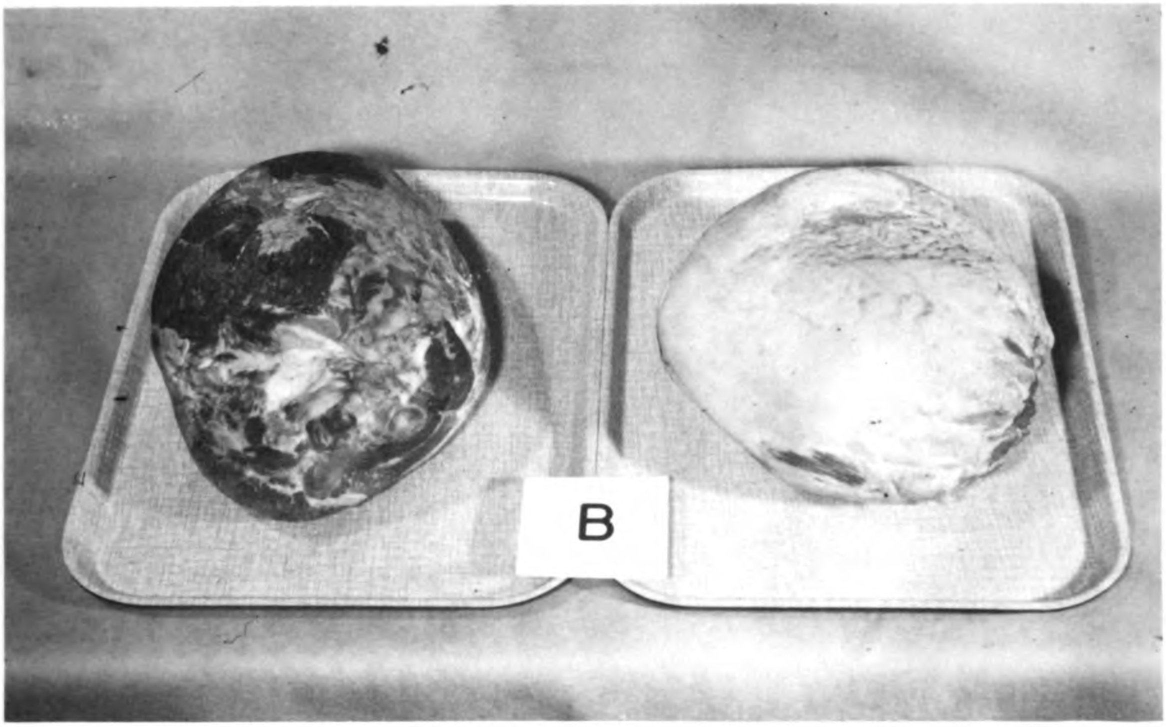

Figure 2. Skinless and shankless style, uncooked and precooked

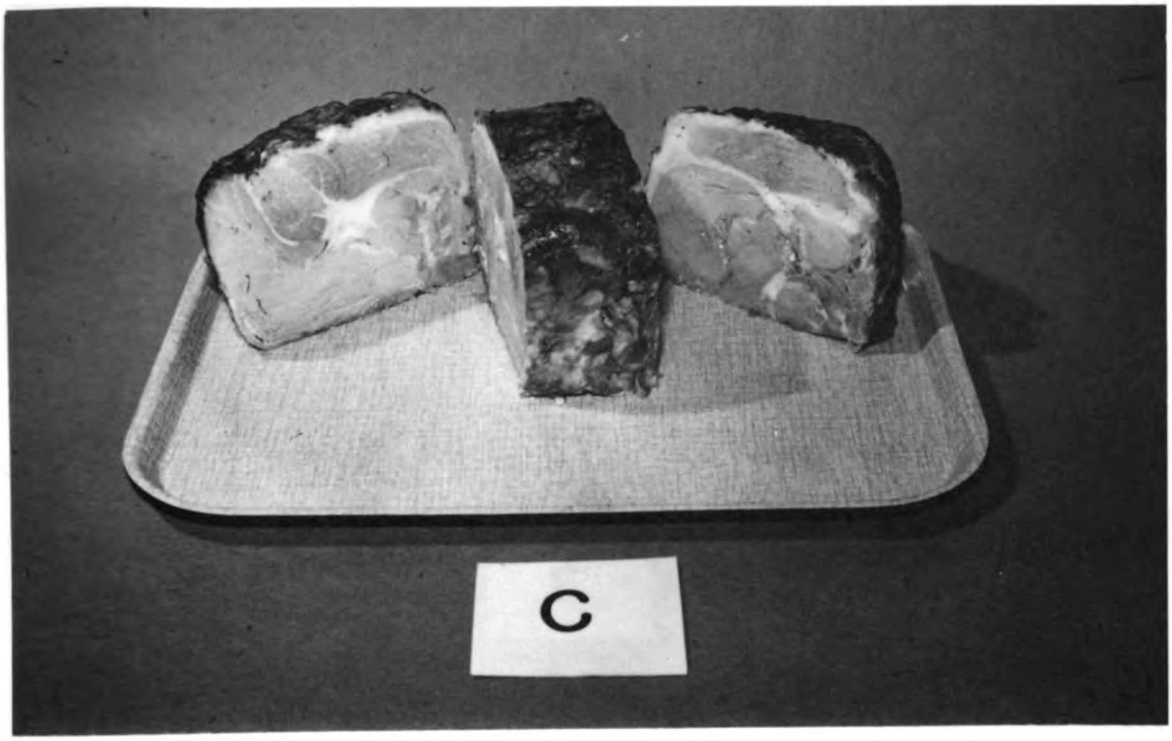

Figure 3. Canned pear-shaped style

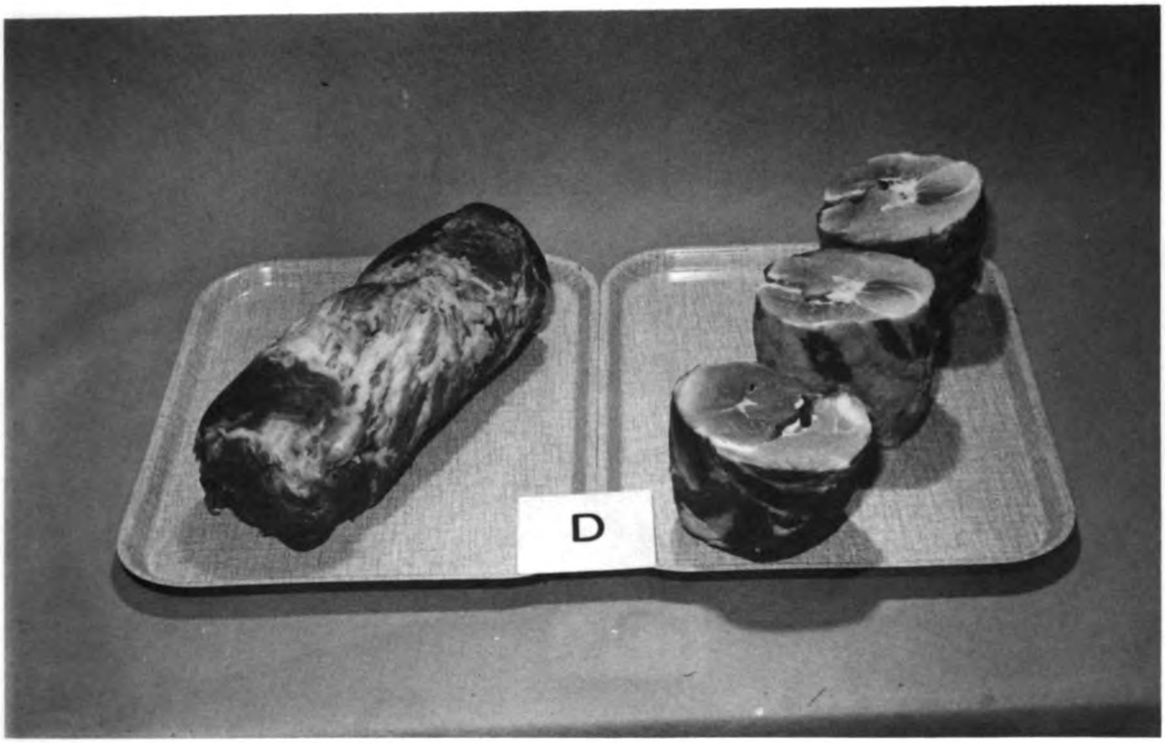

Figure 4. Boned, rolled, and tied style, uncooked and precooked

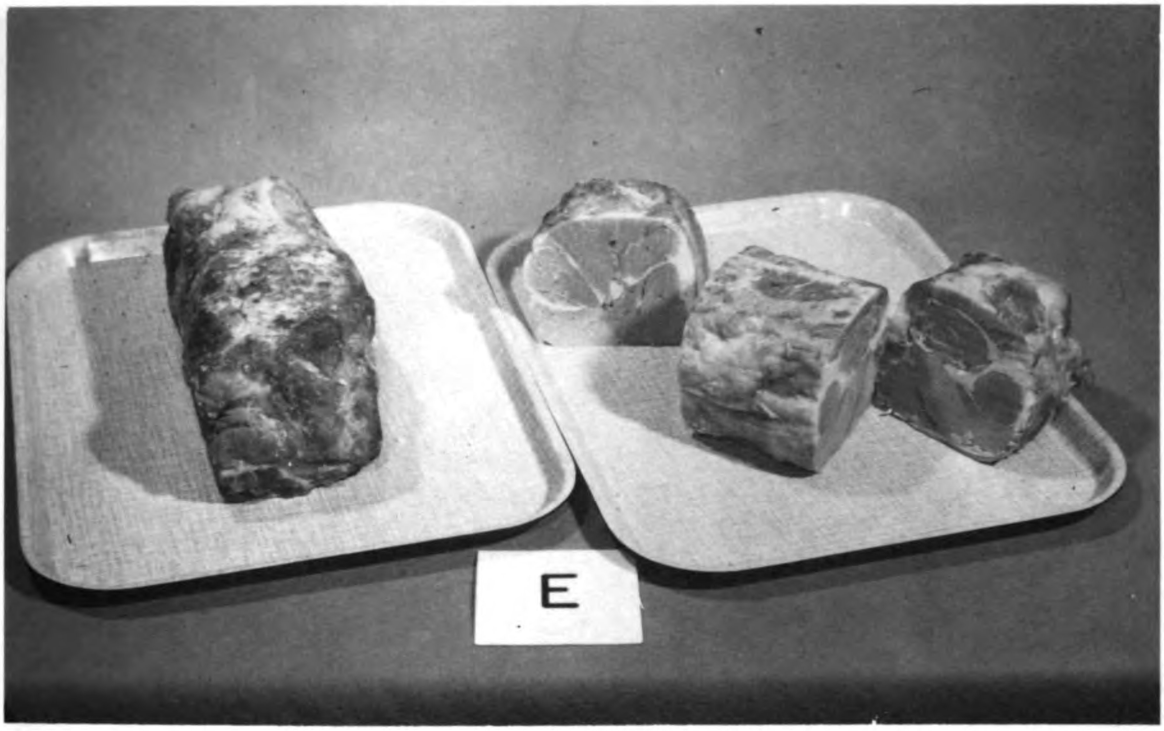

Figure 5. Canned pullman style

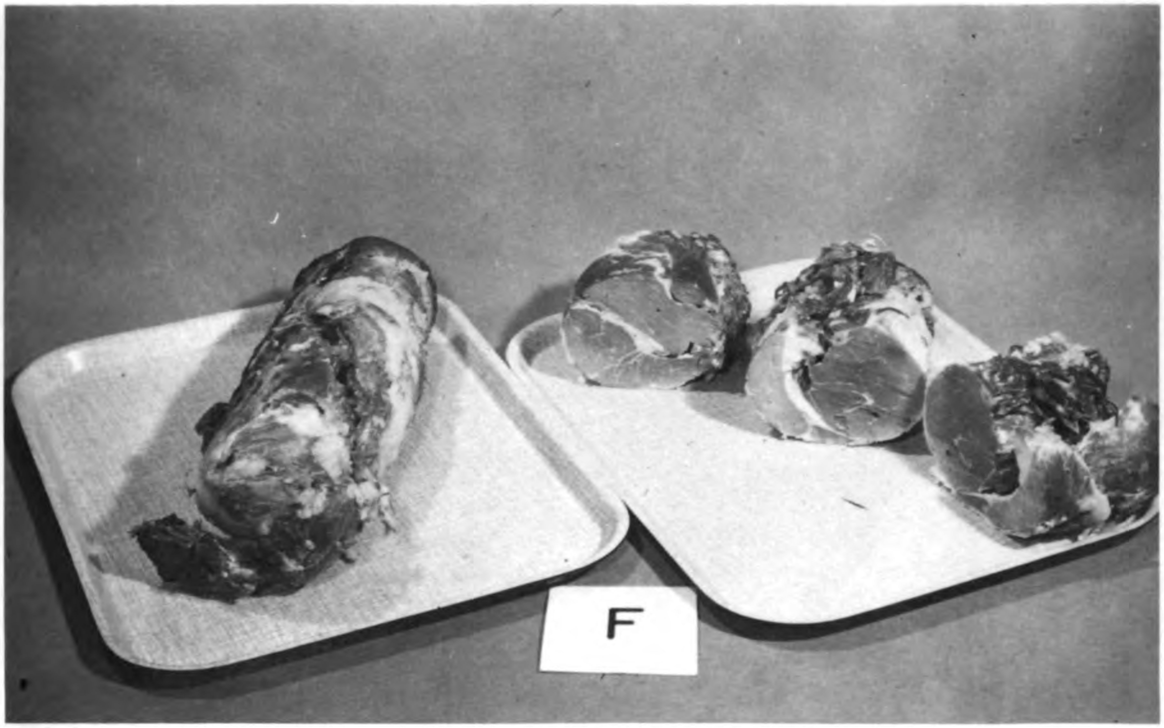

Figure 6. Split style, uncooked and precooked

Methods and equipment were standardized. Appendix B contains a full description of equipment. A variety of brands and styles was included in the six hams prepared each baking day to minimize the effect of individual judges as a source of variance.

Cured hams were obtained directly from three major processors and delivered as needed. They were refrigerated at 1 to 4°C until used. All hams were U. S. No. 1 grade, in a 10 to 12-pound weight range.

Initial weight

The wrapper was removed from the ham, and the initial weight was recorded in grams for the bone-in hams. The visking-wrapped ham weights were recorded in the visking as ham-in-container. After cooking, the initial weight was determined by deducting the weight of the visking case and end plates from the ham-in-container weight. Canned hams were weighed in their containers. The cans were removed, washed, dried, and weighed. To determine the initial weight of these hams before baking, the container weight was deducted from the weight of ham-in-container (Appendix C).

Trimmed Weight

The shank skin was removed from the regular bone-in hams with a boning knife. Starting at the narrowest part of the skin covering, the knife was inserted at the shank end of the ham, pointed toward the wide end of the ham, and the skin carefully split until it could be separated and peeled away from the fat layer beneath. The skin was recorded as weight of trimmings and deducted from the initial weight to determine the trimmed ham weight. For visking-wrapped styles, initial weight and trimmed weight were identical. The gelatin was removed from canned hams, and the ham weight recorded as trimmed weight. The weight of gelatin and loose fat was determined by subtracting trimmed weight from initial weight.

Description and measurement of hams

Appendix C also shows the arrangement of data recorded for description of each ham before baking. These data, collected for examination upon completion of the entire project, are not included in this report. Circumference was recorded in inches by measuring around the widest part of the ham. Length, thickness, and width of the ham were also measured in inches by a device made of three rulers connected with sliding bars. The degree of fat trim on the ham was noted according to the number of lean places exposed on the fat side. A description of the shape of the ham and miscellaneous observations were also noted. The fat depth was measured for the bone-in, skinless and shankless, and pear-shaped canned styles. Other styles did not have a surface covering of fat. Measurements were taken at the shank end, center, right center, left center, and butt end of the ham. The shank length was measured on bone-in hams.

Baking preparation

After the hams had been trimmed, measured, weighed, and described, they were prepared for baking. Short tube-type thermometers, with calibrations from 0 to 105°C at 1°C intervals, were inserted vertically into the hams to one-half the depth of the thickest portion of the ham. The thermometer bulb was as near as possible to the center point of the ham. A long tube-type thermometer, calibrated from -20 to 150°C at 1°C intervals, was inserted diagonally into the ham to permit low temperature readings when the ham was placed in the oven and during the early stages of cooking. This thermometer was inserted from the curve above the shank end (see Figure 7) with the bulb touching the bulb of the short thermometer.

Three slits were made in the covering of the visking-wrapped hams to prevent splitting of the wrapper during baking. Hams were placed with fat side up on square wire racks in labeled roasting pans of known weight.

Baking process

The hams were baked in a 325°F preheated electric roasting oven with top and bottom units on medium setting and dampers closed. Roasting pans were arranged to permit reading of thermometers through glass windows in the oven door. Internal temperature of the hams was recorded at 20-minute intervals until readings reached 70°C. Five-minute readings were then made until the thermometer registered 79°C when the hams were removed from the oven.

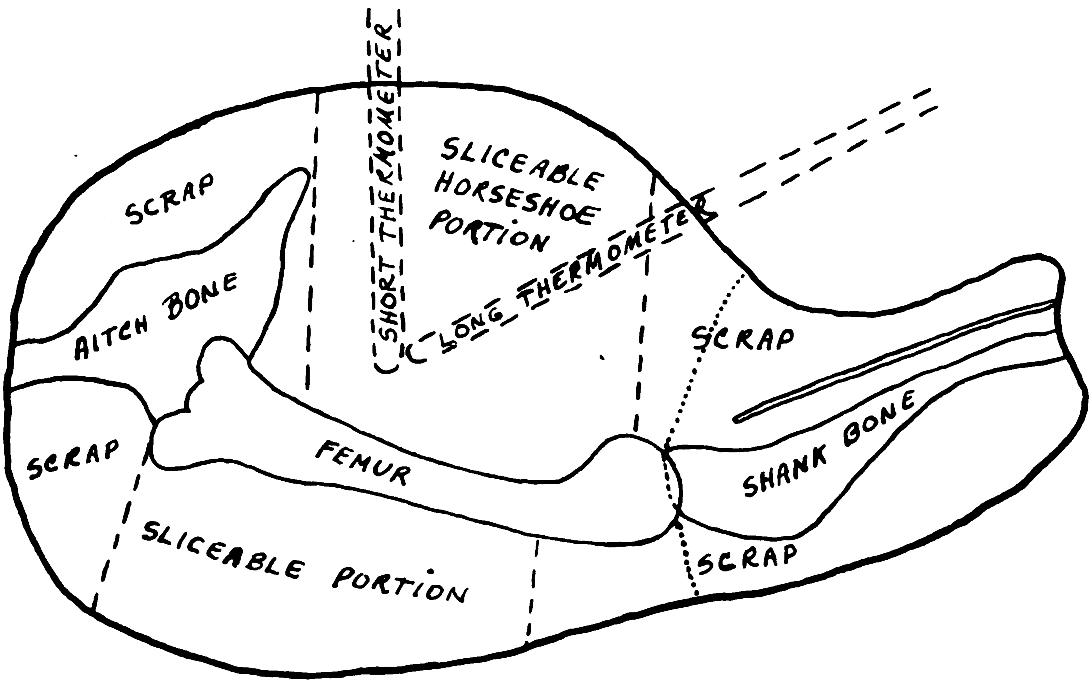

Figure 7. Diagram of sliceable portion, edible scrap, and bones in regular bone-in hams. Skinless-shankless hams have the shank end removed (area to the right of dotted line).

Treatment after Baking

After the hams were removed from the oven, they were left in the roasting pans on racks to cool for 30 minutes.

Hot hams

Visking and metal plates were removed from the boned-rolled-tied and the "splits" while the ham rested on the rack in the roasting pan, and the drippings drained into the pan. Each visking was slit the length of the ham, and the end plates were removed and scraped. The visking was carefully peeled from the entire ham, and any bits of meat clinging to the wrapper were removed. The weight of the visking and end plates was recorded as weight of container. The hams were removed from the roasting pan, placed on labeled aluminum trays of known weight, and refrigerated overnight.

Chilled hams

The drippings that were clinging to the chilled ham were scraped onto the aluminum tray for weighing. The ham was removed from the tray, weighed, and placed on a cutting board. The bone-in-hams and skinless and shankless hams were boned and sliced, and the edible lean scrap was separated from the excess fat. The visking-wrapped and canned hams were completely sliced and the lean scrap was separated from the excess fat.

Bone-in hams. With the ham placed fat side down on the cutting board, the thin meat covering on the outside of the aitch bone was loosened and removed with a boning knife. The tip of the knife was inserted as near to the bone as possible, and slowly manipulated around the entire bone, loosening the connective tissue surrounding the aitch bone (Figure 8). The heavy tendons holding the aitch-bone joint in place were severed to permit removal of that bone.

The next step was removal of the portion of ham beneath the femur. The boning knife was inserted at the shank end of the femur on the side opposite the original aitch bone position. Following along the femur the entire length of the ham, the knife was used to remove the lower portion of the ham in one piece (Figure 9). This piece was then squared on the ends, trimmed of its excess fat, and set aside to be weighed as a sliceable portion.

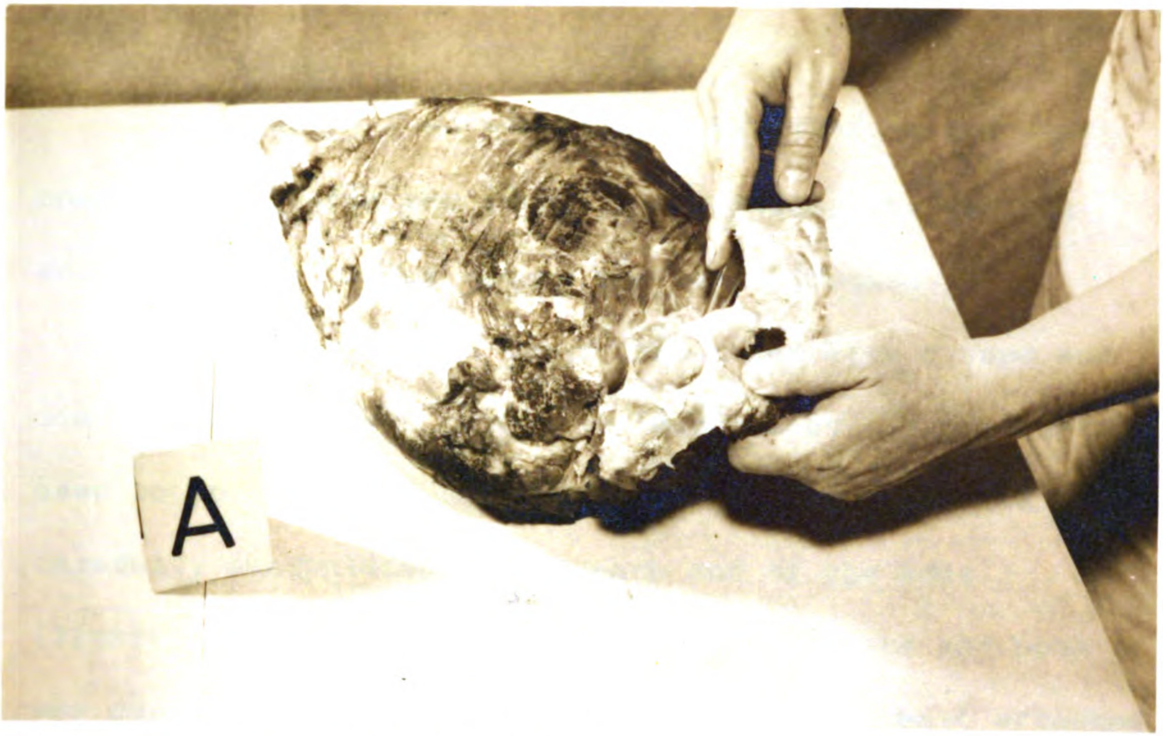

Figure 8. Removing the aitch bone

Figure 9. Removing the lower portion of the ham

The shank bone was removed by breaking the joint connecting it with the femur, and severing the tendons and connective tissue around the joint (Figure 10).

In removing the femur, the connective tissue and meat surrounding the bone were loosened by the same method used to loosen the aitch bone. The boning knife was carefully manipulated around each end of the bone (Figure 11). The tissue behind and underneath the bone was cut, and the bone removed with as little meat attached as possible. The large section remaining (called the horseshoe portion because of its shape) was squared on the ends. The excess fat was trimmed and bits of gristle left from the bone attachment were removed. This piece was also set aside to be weighed as sliceable portion.

Meat, gristle, and fat were removed from the bones. The scrap ham was separated into excess fat, lean usable portion, and inedible trim. Weights for bone-in hams were then recorded for (1) sliceable portion, (2) lean scrap, (3) fat scrap, (4) inedible trim, and (5) bones.

For judging, 1/8-inch slices were prepared from the large upper end of the horseshoe sliceable portion in the same sequence each time. Each judge always received his slice from the same relative position in the section.

Visking-wrapped hams and canned hams. Visking-wrapped hams and canned hams were cut crosswise in thirds and sliced on a mechanical slicer into 1/8-inch slices. After the fatty or gristly slices were put into scrap, the sliceable portions were set aside to be weighed. The scrap ham was separated into excess fat and usable lean scrap. Weights for visking-wrapped hams and canned hams were then recorded for (1) sliceable portion, (2) fat scrap, and (3) lean scrap.

Slices for tasting were taken from the center third of these hams. The first slice came from the point where the eye muscle most nearly resembled that of the regular bone-in style and the remaining slices followed in sequence.

Drippings

The weight of the roasting pan, rack, and drippings from the ham was recorded. The ham drippings were scraped from each rack into the baking pan, and

Figure 10. Removing the shank bone

Figure 11. Removing the femur

poured into a 1000 ml. graduate cyclinder, using a rubber spatula to clean the pan completely. The graduate cylinders were covered with Saran Wrap and stored at room temperature overnight to allow separation of fat drippings and nonfat drippings.

Weight of the coded cooling tray and drippings was recorded. The drippings on the cooling tray were melted and added to the previously collected drippings in the graduate cylinders. The graduate cylinders were placed in warm water for complete separation of fat and nonfat drippings, and the amount of each was recorded in milliliters.

Test Procedures for Evaluation

Cooking losses

The total cooking loss was calculated by deducting the weight of the chilled cooked ham from the weight of the uncooked trimmed ham.

<u>Total dripping loss</u>. The total dripping loss was recorded as milliliters of nonfat drippings and milliliters of fat drippings. Description of the drippings

included the range of color, odor, and clarity for examination at a later date. Total dripping loss was calculated by adding the grams collected in the baking pan to the amount collected on the cooling tray. Appendix C shows sample calculations.

Fat and nonfat dripping loss. Weight of the fat drippings was calculated by multiplying the total milliliters of fat drippings by the specific gravity of the fat drippings. The weight of fat drippings was subtracted from the total dripping loss to determine the weight of nonfat drippings (Appendix C).

Volatile loss. The total dripping weight was subtracted from the total cooking loss weight to determine the volatile loss.

Statistical analysis

Data collected for yield and cooking losses were converted to percentage of trimmed weight. Exceptions were percentage of skin from regular bone-in styles and percentage of gelatin from canned hams which were calculated on the basis of initial weight. Analyses of variance (31) were applied to the data to determine what differences were attributable to ham style (Appendix D). Of the 6 ham styles selected, 4 had both uncooked (137°F) and precooked (150°F) kinds, giving a total of 10 treatments. Ten replications of each treatment were baked; thus data from a total of 100 hams were used in the computations. Mean values for yield, cooking losses, and palatability characteristics were tested for significant differences using the Studentized range table (10). Percentage values were transformed to angles (31) to weight the small percentages more heavily. Results of analysis by percentages and analysis by angles were approximately equal and the interpretation would not have been changed. Analyses of variance were carried out for each of the following items:

Sliceable portion	Skin
Lean scrap	Gelatin and fat
Fat scrap	Fat drippings
Inedible trim	Nonfat drippings
Bone	Volatile losses
	Total cooking losses

Analyses of variance were carried out on average scores for aroma, lean flavor, fat flavor, lean color, tenderness, texture, and juiciness. Comments of judges were summarized and applied to interpretation of the data.

Taste testing

A panel of seven judges was selected from food service operators and laboratory personnel. At two trial panels, judges were instructed in the use of the 7-point score card (Appendix E). Information on the general nature of the project was given, but judges were not informed about specific styles they were judging. The judges were asked not to discuss their impressions in scoring the samples.

A systematic counting of "chews" was used to arrive at a tenderness score. Each judge was instructed to chew a sample of specified size until it was completely masticated. A record was kept of the number of "chews" and the corresponding tenderness score assigned for each sample by each judge at the preliminary trials. These were compiled to set up an individual range for each judge as a basis for his tenderness score for the following panels.

Six samples were presented at each panel to each judge. Tepid drinking water was provided for the judges. The panels met twice each week on the days after the hams were baked for a period covering two months.

RESULTS AND DISCUSSION

This study was directed toward an investigation of the effect of ham style on yield and palatability of mild cured ham. The analyses of variance applied to the data indicated that highly significant differences in yield and palatability were attributable to differences in ham styles.

Tables 1 and 2 show the mean squares and significance for yield, cooking losses, and palatability scores. Differences among averages are listed according to styles in descending order.

Many significant differences were apparent in the data collected for yield and palatability. However, no significant differences among styles were found for inedible scrap, skin, total cooking losses, or juiciness. Very few differences between uncooked (137°F) and pre-cooked (150°F) hams within styles are evident. It is interesting to note that although highly significant differences among styles appeared in fat drippings, nonfat drippings, and volatile losses, the total cooking losses did not show significant differences among averages.

Coding for Table 1

A_1	Regular bone-in, uncooked
A_2	Regular bone-in, precooked
B_1	Skinless and shankless, uncooked
B_2	Skinless and shankless, precooked
C	Canned pear-shaped
D_1	Boned, rolled and tied, uncooked
D_2	Boned, rolled and tied, precooked
E	Canned pullman
F	Split, precooked
F_2	Split, uncooked

Table 1. Mean squares and significance for yield and cooking losses of baked hams.

Treatment	D.F.	Mean Square	Averages* in descending order
Sliceable portion	9	2,263,99**	$D_1E\ F_1C\ \ D_2F_2 > B_1B_2 > A_2A_1$
Lean scrap	9	305.76**	$A_1B_1B_2A_2 > D_2F_2E\ D_1F_1C;\ D_2 > C$
Fat scrap	9	240.14**	$A_2A_1 > B_2B_1 > C > F_2E\ D_2F_1D_1$
Inedible scrap	3	.67	no significance
Bone	3	2.46*	$A_1B_2;\ \ B_2A_2B_1;\ \ A_1 > A_2B_1$
Skin	1	.04	no significance
Gelatin and fat	1	46.40**	$C > E$
Fat drip	9	19.10**	$A_2 > A_1 > B_1B_2 > D_1C\ F_2E\ F_1D_2$
Nonfat drip	9	18.16**	$F_2F_1 > A_1C\ B_1B_2A_2E$; $F_2 > D_2D_1 > C\ B_1B_2A_2E$
Volatile losses	9	22.44**	$E\ C\ F_1D_1B_2 > A_1A_2;\ E\ C > D_1B_2F_2D_2B_1;$ $F_1D_1B_2F_2D_2B_1A_1A_2$
Total cooking losses	9	9.56	no significance

* significant at 5% level of probability

** significant at 1% level of probability

$>$ = greater than grouping that follows

___ = underlining of a group means no significant difference

Coding for Table 2

A_1	Regular bone-in, uncooked
A_2	Regular bone-in, precooked
B_1	Skinless and shankless, uncooked
B_2	Skinless and shankless, precooked
C	Canned pear-shaped
D_1	Boned, rolled and tied, uncooked
D_2	Boned, rolled and tied, precooked
E	Canned pullman
F_2	Split, uncooked
F	Split, precooked

Table 2. Mean squares and significance for palatability scores of baked hams

Treatment	D.F.	Mean Square	Averages* in descending order (10)
Aroma	9	1.03**	$B_1A_2F_1B_2D_1$; $F_1B_2 > F_2C$ E; $B_1A_2 > D_2A_1F_2C$; $D_2A_1 >$ E; $D_1 >$ C E
Flavor-lean	9	.79**	$B_1A_2B_2A_1D_2C$ F_2; $B_1A_2 > D_1F_1E$; $B_2A_1 > F_1E$
Flavor fat	9	.63*	$B_1A_2B_2A_1D_1F_1E$; $B_1A_2 >$ C D_2F_2; $B_2 > F_2$
Color-lean	9	.71*	$A_2A_1F_1B_1D_1F_2B_2D_2$; $A_2A_1F_1B_1D_1 >$ CE
Tenderness	9	6.67**	$B_1A_2A_1B_2D_2D_1F_2C >$ E; $B_1A_2 > F_1E$
Texture	9	1.10**	$A_1A_2B_2B_1$; $A_1 > F_2D_1D_2F_1E$; $F_2 >$ C; $B_1 >$ E C; $A_2B_2 > F_1$E C
Juiciness	9	.30	no significance

* significant at 5% level of probability

** significant at 1% level of probability

$>$ = greater than grouping that follows

__ = underlining of a group means no significant difference

In addition, total cooking loss averages are very close to the results of previous investigators as shown in Appendix A.

From Table 3, showing average percentage values for yield, a division can be noted between bone-in styles and canned and visking styles. Sliceable portion for canned and visking hams is 1½ to 2 times greater than bone-in styles. Lean scrap for the bone-in styles is 2½ to 4 times greater than canned and visking hams. Fat scrap for bone-in styles exceeds canned and visking styles by 1½ to 5 times. Percentages of yield in this study may be compared with results of other investigations in Appendix A. Comparative values for sliceable portion and lean scrap can be seen in Figure 12.

Although average values for total cooking losses did not differ significantly, differences among styles can be seen in the averages for fat drippings, nonfat drippings, and volatile losses.

Mean values for palatability characteristics are listed in Table 4.

Table 3. Percentage mean values for yield and cooking losses of baked hams based on trimmed weight (except ✝)

	Style	Sliceable Portion	Lean Scrap.	Fat Scrap	Inedible Scrap
A_1	Regular, bone-in, uncooked	33.33	18.71	15.34	1.18
A_2	Regular bone-in, precooked	36.06	15.11	14.96	1.48
B_1	Skinless, shankless, uncooked	45.12	16.76	7.45	1.02
B_2	Skinless, shankless, precooked	44.12	16.59	7.52	1.57
C	Canned, pear-shaped	68.58	4.71	4.43	--
D_1	Boned, rolled and tied, uncooked	69.71	5.37	2.63	--
D_2	Boned, rolled and tied, precooked	66.97	8.87	2.98	--
E	Canned, pullman	68.88	6.48	3.10	--
F_1	Splits, uncooked	68.78	5.20	2.85	--
F_2	Splits, pre-cooked	64.67	8.52	3.20	--

✝ percentage based on initial weight

Table 3. (continued)

Bone	Skin†	Gelatin† and fat	Fat Drip	Nonfat Drip	Volatile Losses	Total Losses
8.81	2.54	--	6.51	4.27	11.87	22.65
7.94	2.46	--	9.03	3.57	11.85	24.45
7.64	--	--	5.11	3.62	13.29	22.02
8.06	--	--	4.87	3.57	13.69	22.43
--	--	10.95	2.72	3.66	15.90	22.28
--	--	--	3.15	5.34	13.81	22.30
--	--	--	2.13	5.59	13.47	21.19
---	--	7.90	2.27	2.90	16.37	21.54
--	--	--	2.17	6.12	14.89	23.18
--	--	--	2.66	7.48	13.48	23.62

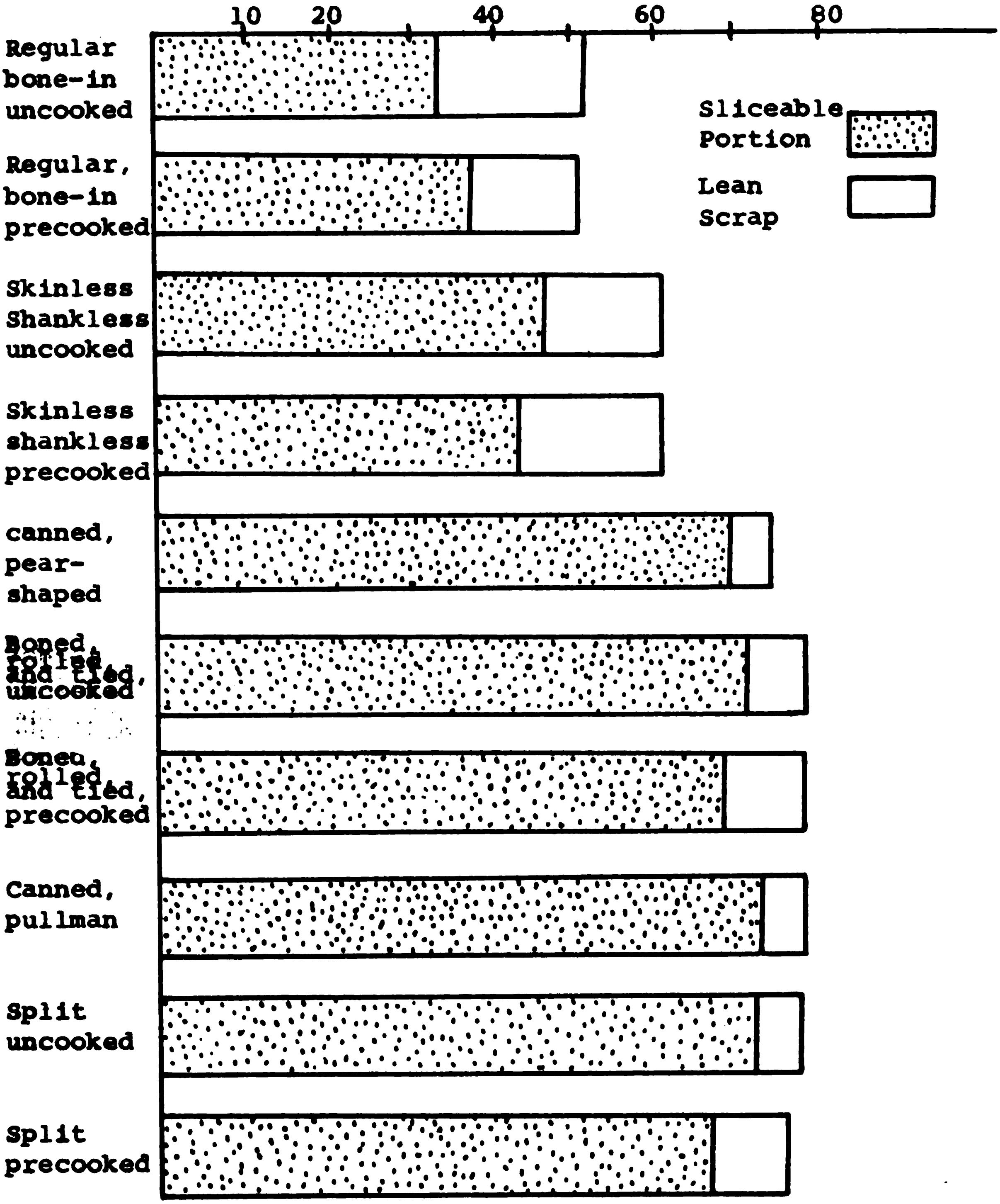

Figure 12. Percentage mean values for sliceable portion and lean scrap of baked hams, based on trimmed weight before cooking.

Table 4. Mean Values for palatability scores* of baked hams

Style		Aroma	Flavor Lean	Flavor Fat	Color Lean	Tenderness	Texture	Juiciness
A_1	Regular, bone-in, uncooked	4.6	4.7	4.7	4.5	4.4	4.7	4.5
A_2	Regular, bone-in, precooked	5.0	4.8	4.9	4.6	4.6	4.5	4.5
B_1	Skinless and shankless, uncooked	5.1	4.8	4.9	4.5	4.9	4.4	4.2
B_2	Skinless and shankless, precooked	4.8	4.8	4.7	4.3	4.4	4.5	4.4
C	Canned, pear	4.2	4.4	4.3	3.9	4.2	3.6	4.0
D_1	Boned, rolled and tied, uncooked	4.7	4.3	4.5	4.5	4.3	4.1	4.5
D_2	Boned, rolled and tied, precooked	4.6	4.5	4.2	4.3	4.3	4.1	4.2
E	Canned, pullman	4.1	4.0	4.4	3.9	3.3	3.9	4.4
F_1	Splits, uncooked	4.9	4.2	4.4	4.5	3.8	4.0	4.2
F_2	Splits, precooked	4.4	4.3	4.2	4.3	4.2	4.2	4.2

*Score averages were rounded to the nearest tenth before statistical analysis.

Regular Bone-in, Uncooked and Precooked

These styles had the lowest percentage of sliceable portion and highest percentage of lean scrap and fat scrap among all styles. The percentage of bone in the regular bone-in hams was significantly higher than the percentage of bone from regular precooked hams.

Regular precooked ham had the highest percentage of fat drippings, differing significantly from regular uncooked ham which was second highest. Nonfat drippings for both these styles were in the middle range, and volatile losses were lowest of all styles.

Of the six palatability scores showing significant differences among averages, regular bone-in appeared in the upper range for all characteristics. Comments of judges indicated that aroma was mild, lean and fat flavors were typical.

Skinless and Shankless, Uncooked and Precooked

The percentage of sliceable portion, although higher than regular bone-in styles, was significantly lower than visking-wrapped and canned styles. The lean scrap percentage for skinless and shankless styles was approximately equal to the regular bone-in styles. Fat scrap was significantly lower than regular bone-in styles and higher than visking and canned styles.

Fat dripping percentage was lower than regular bone-in hams. Percentage of nonfat dripping was lower than regular bone-in uncooked, but higher than regular bone-in precooked. Volatile loss percentage was in the medium range when compared with all styles.

In data collected for palatability, skinless and shankless scores were in the upper range for all characteristics. Descriptive terms emphasized the mild flavor and aroma of these hams. Judges often mentioned coarseness, stringiness, and fiber separation in describing the texture of the hams.

Canned Pear Shaped

Sliceable portion percentage did not differ significantly from any of the other canned or visking styles. However, it was 1½ to 2 times greater than the bone-in style sliceable portion. Percentage of lean scrap was the lowest of all styles; percentage of fat scrap was highest of canned and visking styles but lower than bone-in styles.

This style had a significantly higher percentage of gelatin and fat than the canned pullman style.

Very few differences were noted among canned and visking styles for fat drippings and nonfat drippings. Volatile losses for canned pear shaped hams were higher than all other styles except canned pullman.

Palatability scores ranked this style low in aroma, fat flavor, lean color, and texture. Lean flavor and tenderness scores ranked with other canned and visking styles in the upper ranges. Comments described aroma as mild and sometimes faint, and lean flavor as mild and frequently excessively salty. Fat flavor was typical. Texture was often described as coarse and stringy.

Boned, Rolled, and Tied, Uncooked and Precooked

With the combination of high percentage of sliceable portion, a low percentage of fat scrap, and a high percentage of lean scrap, the yield for these styles is creditable. Fat dripping losses and volatile losses were low. Nonfat dripping percentage was in the medium range.

Scores showed palatability for these styles ranked with other canned and visking styles which ranked slightly below the bone-in styles. Descriptive terms showed that aroma was mild and lean flavor was mild and salty. Coarse, stringy, and spongy textures were mentioned.

Canned, Pullman

In percentages of sliceable portion, lean scrap, and fat scrap, canned pullman ranked with other canned and visking styles. It was higher in sliceable portion and lower in lean scrap and fat scrap than bone-in styles. Gelatin and fat percentage in this style was significantly less than that for pear shaped hams. Fat dripping and nonfat dripping percentages were low, but volatile losses were highest among all styles.

Palatability scores ranked this style lowest of all styles in aroma, lean flavor, lean color, and tenderness. Fat flavor ranked with bone-in styles and with uncooked boned, rolled, and tied hams and uncooked splits. Comments clarify the reasons for these low scores. Although aroma was mild, it was often described as foreign. Lean flavor was objectionably salty. Every ham baked appeared mottled in color and many were irridescent. Texture was frequently described as spongy, coarse, and stringy. A rubbery texture was also noted in several hams.

Splits, Uncooked and Precooked

Sliceable portion, lean scrap, and fat scrap ranked with other canned and visking styles, with a high percentage of sliceable portion and low percentages of fat scrap and lean scrap.

Fat drippings were low, but nonfat dripping percentage exceeded all other styles. Volatile losses were slightly higher for uncooked splits than for precooked split hams. However, both split styles were in the middle range of volatile losses, ranking with other canned and visking styles.

Palatability scores fell in the middle range for most characteristics. Comments of judged indicated that aroma was mild and often faint.

Fat and lean flavor were salty. Texture was sometimes spongy, coarse, or stringy.

SUMMARY

The effect of six ham styles on the yield and palatability of mild cured hams was studied by roasting 100 hams in a 325°F preheated oven to an internal temperature of 79°C. Meat from all styles was separated into sliceable portion, lean scrap, fat scrap, and inedible scrap. Cooking losses were calculated as non-fat drippings, fat drippings, and volatile losses. Palatability scores of seven judges were analyzed for aroma, lean flavor, fat flavor, color, texture, tenderness, and juiciness.

Data were collected from regular bone-in, skinless-shankless, canned pear-shaped, boned, rolled and tied, canned pullman, and split styles of hams. With the exception of canned hams, the styles included both uncooked and precooked kinds.

A pattern of differences, attributable to style, between uncooked averages and precooked averages within styles was not apparent for any yield, cooking loss, or palatability factor.

Canned styles and visking styles had a significantly higher percentage of sliceable portion than bone-in

styles. For the bone-in styles, percentage of sliceable portion was significantly greater for skinless and shankless hams than for regular bone-in hams. Percentage of lean scrap was significantly greater for bone-in styles than for canned styles and visking styles.

Regular bone-in hams, with the highest percentage of fat scrap, differed significantly from skinless and shankless hams. Both bone-in styles had a significantly greater percentage of fat scrap than the canned and visking styles. Percentages of total cooking losses did not differ significantly among the six styles.

Subjective evaluation ranked bone-in styles highest for nearly all the palatability factors. Canned styles ranked lowest in most palatability characteristics. No significant differences among the six styles were found for juiciness.

RECOMMENDATIONS

Interpretation of this investigation is limited by the controlled conditions of this study: roasting 10 to 12-pound mild cured hams at a temperature of 325°F to to an internal temperature of 79°C. The results reported are in no way intended as a recommendation of a method for roasting hams. The methods used were adopted to provide a controlled investigation of the effect of ham style on yield and palatability of mild cured hams.

This investigation has pointed out the need for interested support of the processors in clarifying descriptive terminology and instructions for the preparation of hams of different kinds. Comparative studies under controlled conditions would provide the basis for this information.

Subsequent studies showing yield and palatability of uncooked and precooked hams roasted to internal temperatures lower than the 79°C end point used in this study would provide an interesting and useful comparison with the findings of this study. Study of a lower roasting temperature for precooked hams would also provide additional data on palatability and yield.

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APPENDIX A. SUMMARY OF DATA ON COOKED HAMS

Investigator	No. Hams	Weight in lbs.	Style	Cure	Cooking Method
Rowntree 1925 (28)	--	12-13	bone-in	country	roasted
Purdy 1926 (25)	--	--	bone-in	country	boiled
McElhinney 1927 (23)	2	--	bone-in	country	roasted
Burgoin 1929 (4)	--	14-16	bone-in	country	roasted
		16-18	bone-in	country	roasted
		18-20	bone-in	country	roasted
Staggs 1939 (32)	16	--	bone-in	commer-	baked
	30	--	bone-in	cially	baked
	31	--	bone-in	cured	baked
Alexander and Hankins 1952 (1)	18	12-14	bone-in	country	baked
	2	11	bone-in [illegible]	tender-ized	baked
Dawson et al 1958 compilation of studies (7)	--	--	bone-in	--	baked
	--	--	bone-in	--	baked
	--	--	bone-in	--	boiled
	--	--	bone-in	--	boiled at
	--	--	BRT	--	baked
Downs 1959 (8)	10	12-14	bone-in	rapid	roasted
	10	12-14	sk & sh	rapid	roasted
	10	12-14	cnd pear	rapid	roasted
	10	12-14	BRT	rapid	roasted
	10	12-14	Split	rapid	roasted
Atkinson 1959	10	10-12	bone-in	rapid	roasted
	10	10-12	sk & sh	rapid	roasted
	10	10-12	cnd pear	rapid	roasted
	10	10-12	BRT	rapid	roasted
	10	10-12	cnd pull	rapid	roasted
	10	10-12	Split	rapid	roasted

APPENDIX A. (continued)

Oven temp.	Internal temp.	Total cking loss	Sliceable Portion	Lean Scrap	Edible Portion
		%	%	%	%
350°F	70°C	28.0			
250°F					
180°F	158°F	4.0[a]			
300°F	70°C	26.5	48.5		
257°F					
121°C	70°C	25.2	51.0		
121°C	70°C	23.9	47.8		
121°C	70°C	29.1	46.7		
250°F	70°C	15.1			
300°F	70°C	21.1	65.78	16.33[b]	
375°F	70°C	27.7			
257°F	76°C	16.0			77.0
257°F	76°C	22.0			
325°F	170°F				62.0
325°F	--				46.0
--	--				55.0
350°F	--				50.0
350°F	170°F				62.0
325°F	79°C	23.0	43.4	13.6	
325°F	79°C	24.8	44.4	15.8	
325°F	79°C	23.1	70.8	3.9	
325°F	79°C	23.3	59.9	12.3	
325°F	79°C	27.1	55.6	12.8	
325°F	79°C	23.6	34.7	16.9	
325°F	79°C	22.2	44.6	16.7	
325°F	79°C	22.3	68.6	4.7	
325°F	79°C	21.8	68.3	7.1	
325°F	79°C	21.5	68.9	6.5	
325°F	79°C	23.4	66.7	6.9	

[a] Broth loss only
[b] Listed as "edible scrap"

APPENDIX B. HAM EQUIPMENT LIST

Boning knife -- Wear-ever professional no. 6117, 5½ inch blade.

Graduate cyclinders -- 100 ml, double reading, calibrated at 1 ml. intervals.

Graduate cylinders -- 500 ml. Pyrex brand glass, certified, calibrated at 1 ml. intervals, in accordance with specifications of National Bureau of Standards.

Graduate cylinders -- 1000 m., Pyrex brand glass, certified, calibrated at 1 ml. intervals in accordance with specifications of National Bureau of Standards.

Gram scale -- Torsion Balance Co. 2 kg. capacity.

Gram scale -- Torsion Balance Co. Style 205, 4½ kg. capacity.

Kettle -- 10 gallon capacity with spout.

Ovens, Institutional 2-deck, Hotpoint and Co.

Racks -- wire, 10½ inches square.

Roasting pans -- 12½ x 18½ inches, aluminum.

Ruler device for measuring length and width of ham.

Skewer -- metal, 3 inches long.

Slicer -- General Slicing Machine Co., model 225

Thermometers -- 6 inches long (0° to $105^{\circ}C$) calibrated at $1^{\circ}C$ intervals.

Thermometers -- 12 inches long (-20 to $150^{\circ}C$) calibrated at $1^{\circ}C$ intervals.

Trays -- aluminum, 14 x 18 inches.

APPENDIX C. Sample Data Page

Sample No. Pan. No. ______________

Description of ham before cooking:

Circumference_____Length______ Thickness ______ Width ___________

Degree of trim: Complete ______; Good ______; Fair______; Poor ____

Description of shape and other observations:

Fat depth: Collar ____; Center ____; Left Center___; Right Center _____;

Top _____

		Weight data	Grams	Cooking Loss Calculations	Grams
Ham before cooking	1	Billed Wt. __lb. ___oz.		1 total dripping loss (10)	
	2	Ham in container		Baking pan, rack, drip	
	3	Container		= Baking pan, rack	
	4	Initial Wt. of ham			
	5.	Gelatin And/or fat		cooling pan, drip	
	6	Trimmings			
	7	Trimmed ham		- cooling pan	
Ham after cooking & chilling	8	Cooked & chilled ham		= total loss	
	9	Cooking loss			
	10	Dripping loss		2 - fat drip (11)	
	11	fat		Weight per ml fat drip	
	12	nonfat		x total ml fat drip	
	13	Volatile loss (9-10)		= fat drip	
	14	Bone loss			
	15	Inedible trim			
	16	Sliceable ham - total			
	17	Scrap ham - total			
	18	lean			
	19	fat			

Other remarks and observations:

Hot ham weight:

APPENDIX D. SAMPLE ANALYSIS OF VARIANCE

Analysis of Variance for Sliceable portion

Source of Variance	Degrees Freedom	Sum of Squares	Mean Square	F Ratio
Total	99	23,324.64	--	
Treatments	9	20,375.88	2,263.99	69.11**
Error	90	2,948.76	32.76	

** significance at the 1% level

SCORE CARD FOR HAM

Sample No. ____

Judge ____
Date ____

FACTOR	7 Excellent	6 Very Good	5 Good	4 Fair	3 Poor	2 Very Poor	1 Unacceptable	CHECK MOST DESCRIPTIVE
AROMA								___ mild ___ sharp ___ strong ___ faint ___ foreign
FLAVOR (lean)								___ mild ___ salty ___ typical ___ "old" ___ foreign ___ strong Other ____
FLAVOR (fat)								___ mild ___ salty ___ typical ___ rancid Other ____ ___ foreign
COLOR (lean)								___ light pink ___ medium pink ___ dark ___ mottled ___ irridescent
TENDERNESS								___ cut with fork ___ connective tissue ___ chewy Number of chews ___
TEXTURE								___ spongy ___ coarse & stringy ___ fine ___ separation of fiber
JUICINESS								

REMARKS

YIELD AND PALATABILITY OF SIX STYLES OF MILD CURED HAMS IN

THE 10 TO 12-POUND WEIGHT RANGE

By

Roberta H. Atkinson

AN ABSTRACT

Submitted to the Dean of the College of Home Economics of
Michigan State University of Agriculture and Applied
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for the degree of

MASTER OF SCIENCE

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Approved by Pearl J. Aldrich

ABSTRACT

This investigation, one part of a larger project, deals with the effect of ham style on cooking losses, sliceable portion, scrap portion, and palatability of mild-cured hams in the 10 to 12-pound weight range.

Six styles of hams in this weight range were selected for this study. Regular bone-in, skinless and shankless, splits, and bone-rolled-tied hams were available in uncooked and precooked state. Ten hams of each style were baked. Pullman and pear-shaped canned hams were also included.

Initial weight, trimmed weight, measurements, and a description of the hams were recorded before baking. Hams were roasted in a 325°F preheated oven to an internal temperature of 79°C. Meat from all styles were separated into sliceable portion, lean scrap, fat scrap, and inedible scrap. Cooking losses were calculated as nonfat drippings, fat drippings, and volatile losses. Seven judges scored 1/8" slices of ham for aroma, lean flavor, fat flavor, color, texture, tenderness, and juiciness.

Statistical results showed that no differences were evident between uncooked hams and precooked hams within any style. Canned styles, boned-rolled-tied, and splits had a significantly higher percentage of sliceable portion than bone-in styles. For the bone-in styles, percentage of sliceable portion was significantly greater for skinless and shankless hams than for regular bone-in hams. Percentage of lean scrap was significantly greater for bone-in styles than for canned boned-rolled-tied, and split styles. Percentages of total cooking losses did not differ significantly among the six styles.

Scores ranked bone-in styles highest for nearly all the palatability factors. Canned styles ranked lowest in most palatability characteristics. No significant differences among the six styles were found for juiciness.