USDA Table of Cooking Yields for Meat and Poultry, Release 2

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1. Introduction

Background and Justification: USDA cooking yields and retention factors are important because they serve as a major resource for U.S. and international food composition databases. Most public and private sector databases apply cooking yields to nutrient values as part of the nutrient calculation process where analytical data for cooked foods are unavailable. Composition data are needed for the nutrient value for both the uncooked and cooked forms of foods, but nutrient data for cooked foods are generally not available. Therefore, nutrient composition of a cooked food may be calculated from the uncooked food by applying cooking yield factors to these data to reflect changes in food weights resulting from moisture and fat losses during cooking.

The Nutrient Data Laboratory (NDL) applies cooking yields and/or nutrient retention factors to food formulations and recipes to convert nutrient values for uncooked foods or ingredients into values for cooked foods. Those values are entered into the USDA National Nutrient Database for Standard Reference (SR). The Food Surveys Research Group uses select cooking yields for foods in the USDA Food and Nutrient Database for Dietary Studies (FNDDS). Other Federal agencies use the factors to develop nutrient estimates for foods. Cooking yields describe changes in food weight due to moisture loss (e.g., evaporation or moisture drip), water absorption (e.g., boiling) or fat gains/losses during food preparation and cooking. As food and food preparation methods change over time, it is essential to review and update existing data and acquire new data as needed.

The USDA Table of Cooking Yields for Meat and Poultry was developed with the focus on meats and poultry since most of these products are cooked during the preparation process, resulting in changes in yields. These data, derived from NDL studies, will have benefits for researchers, scientists, nutrition professionals, industry officials, and consumers, such as:

- Valuable information regarding the impact of cooking methods, meat type, and fat content on total cooking yield as well as moisture and fat gain or loss;
- Applicable data for developing nutrient estimates for meats; and
- A practical resource for making decisions regarding food plans and food preparation, e.g., where maximizing cooking yields is a desired outcome.

History: Since 1950, the USDA Agriculture Handbook No. 102 Food Yields (AH-102) has been referenced for use by food service operations, the food industry, database compilers, and university health professionals seeking cooking yield data. AH-102 has been in need of review and revision because limited research has been conducted in this area in recent years. In the past, these data were available in hard copy form. New data processing capabilities in the Nutrient Data Bank System enabled calculation of yields and moisture/fat changes using data for weight changes and nutrient records and provided the mechanism for dissemination of these data in electronic format.

To prepare the USDA Table of Cooking Yields for Meat and Poultry, a series of steps were involved. Data were obtained through recent contract analyses performed at the University of Wisconsin and Texas Tech University on a number of meat and poultry products. Where recent analytical data were not available, data in AH-102 were applied to food nutrient values and weight updates in the USDA National Nutrient Database for Standard Reference. Then, yield data from AH-102 were reviewed, revised and assimilated. Revisions included changes in some food descriptions, categorization of preparation methods, and incorporation of updated data for % yield, % moisture change and % fat change. New fields such as food identifiers and statistical information were added. Data were obtained by determining moisture and weight change on various foods in NDL's contracted laboratories.

The data in the USDA Table of Cooking Yields for Meat and Poultry Release 1 included results from the following research studies:

- Ground Beef
- Beef, Selected Cuts, 1/8 inch External Trim Fat
- Beef Value Cuts
- Beef Nutrient Database Improvement
- Alternate Red Meats
- Natural Fresh Pork
- Cured Ham
- Enhanced Pork
- Pork Value Cuts
- Ground Pork
- Pork Loin
- Variety Meats
- Pork Sausage
- Turkey Sausage

For Release 2, results from these research studies have been added:

- Chicken Drumsticks and Thighs
- Whole Turkey
- Turkey Retail Parts
- Veal Retail Cuts

The USDA Table of Cooking Yields is being released in PDF and MS Excel formats on the Nutrient Data Laboratory web site at http://www.ars.usda.gov/nutrientdata.

Equations and Definitions

N is a Nutrient value (could be either lean or lean + fat)
W is a Weight
First subscript identifies if it is from the cooked or raw sample
Second subscript identifies if it is the hot cooked weight or raw weight

N_c	=	Nutrient content of cooked sample (lean or edible portion)
N_r	=	Nutrient content of raw sample (lean or edible portion)
W_{ch}	=	Weight of cooked sample while hot
W_{cr}	=	Weight of sample before cooking (its raw weight)
E_c	=	Edible portion cooked weight
E_r	=	Edible portion raw weight

The equation for calculating cooking yield is:

Yield (%) = 100 x (Wch / Wcr)

The cooked sample's raw weight (Wcr) is recorded before cooking. The cooked sample's hot cooked weight (Wch) is recorded after the sample has been cooked (while sample is hot, after a very brief specified resting time) using the specified cooking method.

In addition to calculating the cooking yield, the % Moisture Change and % Fat Change are calculated. The equation used for calculating % Moisture Change is:

Moisture change (%) = 100 x ((Nc x Ec) – (Nr x Er)) / Wcr

The equation used for % Fat Change is the same as above, except that fat values are substituted for water values. This percent change for moisture or fat could be positive or negative, indicating a gain or loss, respectively.

This information was entered and processed through the National Data Bank System (NDBS). NDL used these data to develop the USDA Table of Cooking Yields for Meat and Poultry.

2. Sources of new data

Selection of specific cuts for the studies described were based on recommendations from market share data, key foods (Haytowitz et al., 2002), and recommendations from experts in the meat industry.

Ground Beef Study

The USDA, in collaboration with America's Beef Producers and the University of Wisconsin, undertook a study funded by the Beef Checkoff Program to update the nutrient composition data for ground beef products in SR. None of the ground beef products contained extenders. According to Federal regulations, ground beef has no added water, phosphates, binders, or extenders, and shall not contain more than 30 percent fat (USDA, FSIS, Code of Federal Regulations, 2003). Ground beef is a unique meat product in that a wide range of formulations for this product are available in most U.S. retail stores. In order to provide consumers and industry with the nutrient composition information for this variable product, the study was designed to establish the mathematical relationship between the various nutrients and the total fat content of raw ground beef through regression techniques. The ultimate aim was to use these relationships for predicting the nutrient composition for raw and prepared ground beef.

Sampling: For the first phase of this study, ground beef samples for each of three fat categories (label declarations of <12% fat, 12-22% fat, or >22% fat) were purchased from 24 retail outlets nationwide. In this sampling plan developed for the NFNAP (Pehrsson, P.R. *et al*., 2000), the country was divided into 4 regions, with 3 consolidated metropolitan statistical areas (CMSA) within each region, with 2 retail stores selected within each CMSA. To obtain updated data at lower levels of fat reflecting current retail market trends, a second phase of the study was conducted, using the NFNAP sampling plan with 12 nationwide retail locations to procure additional ground beef products of various fat levels.

Cooking Procedure: All ground beef patties were cooked to a final internal temperature of 160°F/71°C. No fat was added during cooking. Broiling was done in a preheated conventional oven for 8.7 minutes. Pan-broiled patties were broiled in a preheated West Bend electric skillet for 11.75 minutes. Patties were cut in half to evaluate degree of doneness based on color. Ground beef crumbles were cooked in a preheated West Bend electric skillet for 5.3 minutes and drained in a colander. The loaf was baked in a conventional oven at 325°F/163°C for 41 minutes. After cooking, all samples were placed in plastic bags which were vacuum sealed and stored at -11°F/-24°C until homogenization and analysis. Samples were weighed prior to and after cooking in order to calculate cooking yields.

Sample analysis: Raw samples and broiled patties from each location and for each fat level (n=72) were analyzed for moisture and total fat, in the first phase of the study. For the second phase of the study, moisture and total fat were determined (n=36). Quality assurance was monitored through the use of certified reference materials, in-house controls, and random duplicate sampling. Moisture content was determined using AOAC method 950.46 – Loss on Drying (Moisture in Meat). Fat was analyzed using acid hydrolysis. The acid hydrolysis method extracts fat from the sample by subjecting it to hydrochloric acid followed by extraction with mixed ethers. The hydrochloric acid breaks fatty acids from the glycerides, glyco- and phospholipids and sterol esters. Acid

hydrolysis also breaks lipid-carbohydrate bonds, assists in the hydrolyzing of proteins and polysaccharides, and disrupts cell walls. All of these processes make the lipids available for complete extraction with mixed ethers; the ether is evaporated and the extracted residue is weighed. With ground product, there is much more opportunity for moisture and fat loss because of the product's open and disrupted texture. The change in nutrient content between raw and cooked products is used to estimate moisture loss and fat loss during cooking.

Beef, Selected Cuts, 1/8 inch External Trim Fat Study

A collaborative study was conducted by USDA, America's Beef Producers, and Texas A & M University to determine the food and nutrient composition of 13 raw and cooked retail cuts for SR.

Sampling and fabrication: Carcasses (n=20) were selected from two packing plants, one in the Texas panhandle and the other in Nebraska. Ten USDA Choice and ten USDA Select, yield grade 2 and 3 carcasses were selected. These carcasses represented the approximate distribution found in the U.S. beef supply according to the National Quality Beef Audit – 1995 (Boleman et al., 1998). All carcasses were shipped to Texas A&M University for fabrication of the following retail cuts: Arm Roast, Bottom Round Roast, Bottom Round Steak, Brisket – Flat Half, Eye of Round Roast, Flank Steak, Round Tip Roast, Small-end Rib Steak, Tenderloin Steak, Tri-tip Roast, Top Loin Steak, Top Round Steak, and Top Sirloin Steak. Cuts were assigned randomly to the following external fat trim levels: 0.0 cm (0 inch trim), 0.3 cm (1/8 inch trim), or 0.6 cm (1/4 inch trim). For 1/8 inch and 1/4 inch fat trim samples, separable fat was removed for analysis with a scalpel. One additional steak or roast per cut was assigned to a raw treatment and trimmed to 0.3 cm. Three of the cuts (flank steak, round tip roast, and tri-tip roast) had no external fat and were therefore assigned to the 0.0 cm group for both preparations (raw and cooked). Dried surfaces, extending chine bones, minor muscles, and muscle pieces were trimmed from all cuts. All cuts were vacuum packed individually, labeled, and frozen at -9°F/-23°C for further dissection and cooking. Additional details on fabrication have been previously published (Wahrmund-Wyle et al., 2000).

Sample preparation: All cuts, both raw and cooked, were carefully dissected to separate and weigh the various cut components. These components included separable lean, external fat, seam fat, and waste such as bone and heavy (non-edible) connective tissue. The separable lean included muscle, intramuscular fat, and connective tissue that would be considered edible. Separable lean was placed in a Cuisinart® food processor and homogenized for 35 seconds.

External fat was comprised of the fat on the outside of the cut. Seam fat included intermuscular fat depots within the cut. Separable fat, which was external and seam fat from all cuts, was pooled to form raw and cooked composites. As was done for the lean, separable fat was homogenized in a Cuisinart® food processor. Sample aliquots of separable lean and separable fat were frozen at 14°F/-10°C until analyses.

Cooking procedures: Retail cuts were thawed overnight in a cooler at 41°F/5°C, weighed, and cooked using standard protocols (Wahrmund-Wyle et al., 2000).

Braising - Arm roast, bottom round steak, and brisket cuts were browned for 4-8 minutes (time being size dependent) in a preheated 325°F/163°C Farberware Dutch Oven placed on top of a conventional range. After browning, the cuts were covered with 90-180 ml distilled water, placed in a conventional gas oven preheated at 325°F/163°C and simmered in a covered pan to an internal temperature of 185°F/85°C.

Roasting - Bottom round roast, eye of round roast, round tip roast, and tri-tip roast cuts were placed on wire racks with the fat side up, when possible, and cooked in a preheated conventional gas oven (325°F/163°C) to an internal temperature of 140°F/60°C.

Broiling - Flank steak, small-end rib steak, tenderloin steak, top loin steak, top round steak, and top sirloin steak cuts were cooked on electric Farberware Open-Hearth Broilers (model 350A) to an internal temperature of 149°F/65°C.

The internal temperature of each retail cut was monitored by inserting thermocouples into the geometric center of the cut and recording the data on Honeywell recorders. Each cut was weighed prior to and after cooking for calculation of cooking yield. After cooking and being allowed to rest for a short time, cuts were weighed then wrapped in plastic wrap and chilled (36-37°F/2-3°C) overnight (Jones et al., 1992).

Nutrient analysis: Individual samples, cooked and raw, were evaluated for separable lean, external trim fat, seam fat, and waste (bone and heavy connective tissue). Cooking yields were calculated from the initial (raw) and final cooked weights. Moisture and total fat content were determined on individual samples of lean tissue and composites of the separable fat. Quality assurance was monitored through the use of certified reference materials, in-house controls, and random duplicate sampling. Moisture analysis was performed using the oven-drying method 950.46 (AOAC, 2000). Samples were weighed into pre-dried, pre-weighed crucibles and allowed to dry for 16-18 hours at 212°F/100°C in an air oven. The samples then were cooled in a desiccator and weighed. Loss in weight was reported as moisture. Lipid was extracted using a modified Folch et al. (1957) method. Samples were homogenized with 20 ml chloroform: methanol (2:1) solution in a 50 ml screw cap polypropylene tube. The homogenate was filtered through a Buchner funnel with slight suction. The filter was rinsed with chloroform-methanol. The filtrate was transferred back into the 50 ml tube, and 8 ml 0.74% KCl solution was added. After separation, the upper phase was siphoned off and the lower phase was transferred into pre-dried, pre-weighed beakers. The lower phase of the filtrate was evaporated for 24-36 hours at room temperature in the hood and then dried at 212°F/100°C for 1.5 hours.

Beef Value Cuts Study

USDA, in collaboration with America's Beef Producers and the University of Wisconsin, conducted a study funded by the Beef Checkoff Program to determine the nutrient profile of a line of cuts known in the beef industry as "Beef Value Cuts", for inclusion in SR. These single-muscle roasts and steaks, introduced to the U.S. retail market in 2001-2002, were fabricated from the outside round, knuckle, and chuck shoulder clod. These cuts were marketed for their palatability and functionality. Furthermore, five of the six major cuts met the USDA definition of lean or extra lean. The cuts in the study consisted of Top Blade Steak (Infraspinatus), Shoulder Top and Center Steaks (Triceps brachii), Shoulder Tender (Teres major), Tip Center (Rectus femoris), Tip Side (Vastus lateralis), and Bottom Round (Biceps femoris).

Sampling and Sample Preparation: Samples were obtained from an IBP (Tyson) plant near Sioux City, Iowa, which obtains cattle from a large number of feedlots and has nationwide product distribution. Twelve carcasses were identified by quality grade (upper choice, lower choice, and select) with yield grades of 2 or 3. Sufficient product from each carcass was obtained to prepare and analyze five of the six cuts. However, the Teres major is a very small muscle (weighing only ~16 oz per carcass), which would not provide a sufficient amount for all analyses. Therefore, one 15-pound box of choice and one 15-pound box of select Teres major muscles were purchased from the plant. Samples were trimmed free of all external fat and heavy connective tissue. The denuded muscles were then vacuum-packaged and stored at -20°F/-29°C until preparation for analysis. Samples were cut into 1-inch thick steaks and weighed. Samples were paired, with one steak for raw analyses and the other to be cooked and analyzed after cooking.

Cooking procedure: Steaks were cooked by grilling on a preheated gas grill. Steaks were turned when the internal temperature reached the midway point between the starting temperature and final internal temperature (including post-cooking temperature rise) of 160°F/71°C. Steaks were placed on a wire rack for three minutes then weighed to obtain cooked weights. Raw and cooked steaks were stored at -20°F/-29°C until nutrient analyses.

Nutrient analysis: Samples were analyzed for moisture and fat content using individual muscle samples from the chuck clod, bottom round, and the knuckle, both raw and cooked. Moisture and fat analyses have been previously described in the Ground Beef Study section of this report. Cooking yield calculations were based on initial (raw) and final cooked weights from all samples.

Beef Nutrient Database Improvement Study

A collaborative research study was undertaken by USDA with scientists at the National Cattelemen's Beef Association (NCBA), Colorado State University (CSU), Texas A & M University (TAMU), and Texas Tech University (TTU) to update nutrient information in the SR and to add new cuts which had been introduced in the market place since the

previous update. The first phase of this study involved cuts from the chuck: Brisket, Mock Tender Steaks, Top Blade Steaks, Boneless Shoulder Steaks, Shoulder Clod Roasts, Boneless Chuck Short Ribs, Denver Steaks, Chuck Eye Steaks, Country Style Ribs, America's Beef Roast, Underblade Steaks and Roasts, and Beef for Stewing. The second phase of this study involved cuts from the rib and plate: Back Ribs, Rib Eye Roast, Rib Eye Steak, Outside Skirt, and Inside Skirt. The third phase included cuts from round and loin: Porterhouse Steaks, T-bone Steaks, Top Loin Steaks, Tenderloin Steaks and Roasts, Eye of Round Steaks and Roasts, and Top Round Steaks and Roasts.

Sampling: Beef carcasses were selected from different major packing plants in six states, representing different regions of the U.S. Each university was assigned two packing plants. The sampling plan was developed for 36 animals. In order to get true retention and yield data, an A and a B side of the animal carcass was needed; thus the total animal count came to 72. When selecting the carcasses, certain properties were considered as part of the sampling plan protocol: quality grade (upper choice, lower choice, select), yield grade (YG2, YG3), gender (steer or heifer), and genetics (dairy or non-dairy). Each university was responsible for identifying and obtaining beef chuck, rib and plate cuts that matched the sampling matrix. The university collaborators assessed and recorded carcass data at the packing plants, properly identified each selected cut, and shipped the products back to the respective meat laboratories. Products were fabricated into the required retail cuts for this study within 14-21 days postmortem. Retail cuts were properly identified, vacuum packaged and held frozen until cooking or dissection. The retail product was cooked according to standard protocols developed for each cut. Cooked and raw products were dissected; weights for each component (separable lean, separable fat, and refuse) were obtained. Total weights for raw and cooked cuts (prior to and after cooking, respectively) were obtained. Aliquots of the separate components were then homogenized and composited according to a standard compositing plan. The compositing plan was used to establish an effective and efficient statistical design for nutrient analyses of the beef cuts. The plan consisted of four different compositing levels: an animal level (36 animals) where all the samples were analyzed; a six composite level; a three composite level; and a national composite level. This was done for both raw and cooked samples. Different nutrients were analyzed at each composite level.

Sample preparation: The various beef cuts were analyzed in raw and cooked form. The following cooking methods were used: grilling, roasting, and oven-braising. Frozen raw samples were tempered under refrigeration (32-39°F/0-4°C) for 24 to 48 hours until they reached a defined starting temperature; the timing was based on the appropriate size and weight of the cut. The appropriate temperatures and weights were recorded prior to cooking. The thermocouple was placed in the geometric center or thickest portion of the meat piece. The probe positioning did not affect the product's contact with the cooking surface. For small or thin beef cuts, the thermocouple was used periodically to check the internal temperature of samples throughout the cooking process.

Cooking Procedures:

Grilling - The grill was preheated to 383°F/195°C. The beef samples were evenly spaced in the center of the cooking grate. The grill lid was closed. Samples were removed

from the grill once an internal temperature of 158°F/70°C was obtained. Tongs or spatulas were used to remove samples from the grill. Beef samples were allowed to stand while monitoring the internal temperature rise until temperatures began to decline. The point right before the temperature declined (the highest temperature reached) was considered to be the final internal temperature of the cooked sample. The final internal temperature and cooked weight (to nearest 0.1 gram) were recorded immediately. Beef samples were then chilled uncovered in the refrigerator (36-39°F/2-4°C) for 24 ± 1 hr before dissection.

Roasting - The oven was preheated to 325°F/163°C. The beef samples were positioned in the center of the rack in the roasting pan, no oil or water was added, and the pan was not covered. The roasting pan with the beef sample was positioned on the oven rack in center of oven and roasted to an internal temperature of 140°F/60°C. The beef samples were removed from the oven. After resting 30 minutes at room temperature, the weight of each sample was measured and recorded to the nearest 0.1 gram. The thermocouple probe remained in place and samples were allowed to stand while monitoring the internal temperature rise until temperatures began to decline. The point right before the temperature declined (the highest temperature reached) was considered to be the final internal temperature of the cooked sample. The beef samples were then chilled uncovered in refrigeration (36-39°F/2-4° C) for 24 ± 1 hr before dissection.

Oven-Braising - The beef samples were placed in a preheated pan and were "browned/seared", turning as needed for even browning on all sides. The pan drippings were poured off and the volume (ml) of drippings was measured. The thermocouple was then applied in the geometric center or thickest portion of the meat piece. A small amount of distilled, deionized water was added until the water reached one third of the thickness of the meat. The liquid was held at a simmer. The pan was covered with a lid and placed in the Dutch oven. The Dutch oven was then placed in a preheated 250°F/ 120°C oven. The beef samples were simmered and cooked until an internal temperature of 185°F/85°C was reached. The sample cuts were removed from the oven keeping the thermocouple probe in place and were allowed to stand while monitoring the internal temperature rise until temperatures began to decline. The point right before the temperature declined (highest temperature reached) was considered the final internal temperature of the cooked sample. The beef samples were removed from cooking liquid; the cooking liquid yield and volume were documented. Sample weights were measured (to the nearest 0.1 gram) 30 minutes after removal from heat. The beef samples were then chilled uncovered in the refrigerator (36-39°F/2-4°C) for 24 ± 1 hour before dissection. For back ribs that were also oven-braised, the "browned/seared" step was not performed.

Nutrient Analysis: Raw and cooked samples were prepared and chemically analyzed for moisture and total fat. Quality assurance was monitored through the use of certified reference materials, in-house controls, and random duplicate sampling. Total fat was analyzed by acid hydrolysis. Two of the universities involved in this study used the extraction method for total fat as cited in Folch et al. (1957) with some modifications. In this method the extract is shaken and equilibrated with 1:4 volume of a saline solution,

which causes the mixture to partition into two layers. The lower phase is composed of chloroform-methanol-water in the proportions 86:14:1 (by volume) and contains virtually all of the lipids, while the upper phase consists of the same solvents in the proportions of 3:48:47 (by volume), respectively, and contains much of the non-lipid contaminants. A qualified laboratory under contract to NDL determined total fat using a modification of AOAC method 989.05: Fat in Milk, Modified Mojonnier, Acid Hydrolysis. In this method, fat is extracted with a mixture of ethers from a known weight of the sample. Ether extract is decanted into a pre-weighed dry weighing dish, and the ether is evaporated. The extracted fat is dried to a constant weight. The result is expressed as % fat by weight. Moisture was analyzed by forced air, a combination of AOAC oven-drying methods 950.46 and 934.06. In this method the test sample is spread out over the base of a dish and the test portion is dried containing about 2 grams of dry material for approximately 16 to 18 hours at 212-216°F/100-102°C in an air oven. The sample is then cooled in a desiccator and weighed. The loss in weight is reported as moisture in grams.

Alternate Red Meats (ARM) Study

During the 1990's, alternate red meat sources such as farm-raised bison, elk, deer, emu and ostrich became more available. Since nutrient data were limited for these products, the USDA funded a research project at the University of Wisconsin called "Alternative Red Meat: Marketing and Processing Improvement" (ARM) to determine nutrient content of ARM products. Nutrient data were released in SR in 2002. Sample weights before and after cooking were collected to determine cooking yield factors for these products.

Sampling:

Ostrich - Two-pound samples of 97% lean ground ostrich were acquired from each of seven production lots at Blackwing Ostrich Products in Antioch, IL.

Emu - Sample selection sites were based upon recommendations from the American Emu Association (AEA). The AEA viewed differences between geographic location, management schemes and rations to be important when selecting sampling sites. The sample collection sites chosen were Johnson Emu (Eva, AL), Dino Meats (Springfield, TN), and Grangeville Meats (Grangeville, ID). Johnson Emu was the largest emu processor in the United States with approximately 500 growers representing 16 states. Dino Meats and Grangeville Meats were smaller regional operations. Two-pound samples of 97% lean ground emu were acquired from each of the seven production centers.

Venison (fallow deer) - The two sample collection sites for the analysis of venison were Venison America (Newport, MN) and Wisconsin Venison (Green Bay, WI). These two companies represented the two largest venison wholesalers in the upper Midwest, each with approximately nine contract growers located in Iowa, Illinois, Minnesota, and Wisconsin. Three-pound samples of 93% lean ground venison were acquired from each of seven patty production lots.

Bison - The sample collection site for the bison was the North American Bison Co-op (NABC) in New Rockford, ND. NABC harvests approximately 60% of the North American bison yearly and represents 350 producers across 19 states and four Canadian providences. For bison, whole muscle cuts, i.e., shoulder clod (Triceps brachii, 3-5 lb roast), top round (Semimembranosus, 1" steaks), and ground products were collected. The cuts were obtained from seven randomly selected carcasses, each representing a different production lot. Left and right side (i.e., contra-lateral) portions were obtained from shoulder clods and top rounds for determination of cooking yields and retention of moisture and total fat. All individual portions were identified, vacuum packaged and frozen prior to transport to the University of Wisconsin Meat Science lab. One-inch steaks and individual roasts were then fabricated and vacuum packaged. Three-pound samples of 88% lean ground bison were obtained from each of seven production lots.

Elk - Because of strong interest from the industry and the Nutrient Data Laboratory, ground meat from elk was included. The ground elk came primarily from young bulls (1.5 to 2.5 years of age), although one sample came from a larger, six-year-old bull. Samples were obtained from producers/plants in Colorado, Nebraska and Wisconsin.

Cooking Procedures: Products were cooked according to meat cooking guidelines developed by the American Meat Science Association and recommendations of ARM associations. Loin, rib, sirloin and leg/round cuts were broiled and the ground meats were pan-broiled to a final internal temperature of 160°F/71°C. Clods/shoulders were braised; cooking times were based on standard meat cookery guidelines. Cooked and raw products were dissected to obtain weights for these components: trimmed lean, separable fat, and heavy connective tissue.

Nutrient Analysis: Frozen samples were packaged and sent to qualified commercial laboratories for analysis of moisture and fat. Moisture and fat analyses have been previously described in the Ground Beef Study section of this report. Ground product has much more opportunity for moisture and fat loss because of the product's open and disrupted texture. The nutrient change between raw and cooked products (when the amount of each is kept equal, such as 100 grams of each) is a reflection of moisture loss (and maybe some fat loss) during cooking.

Natural Fresh Pork Study

A study was conducted by USDA in collaboration with scientists at the University of Wisconsin and the National Pork Board to determine the nutrient composition of nine fresh pork cuts. The cuts chosen for evaluation were: Bone-in Shoulder Blade Steak, Boneless Tenderloin Roast, Boneless Top Loin Chop, Boneless Top Loin Roast, Bone-in Sirloin Roast, Bone-in Center Loin Chop, Bone-in Center Rib Chop, Bone-in Country-Style Ribs, and Bone-in Spare Ribs.

Sampling: Nine fresh pork cuts were pre-ordered and purchased from 12 retail outlets following the nationwide sampling plan developed for the USDA National Food and

Nutrient Analysis Program (NFNAP) (Perry et al., 2003) and shipped frozen to the University of Wisconsin for trimming and preparation. Products from each location were assigned randomly to either raw or cooked preparation.

Cooking procedures:

B**roiling** - Center loin chops, center rib chops, and top loin chops were grilled on a preheated George Foreman™ Indoor/Outdoor Electric Barbeque Grill for ten minutes on setting "4". External fat thickness and chop thickness were measured prior to cooking; weights of raw cuts were obtained. Two thermocouples were placed into one or two chops, as needed. Chops were turned over when the internal temperature reached 100-105°F/38-40°C. Chops were removed from the grill at approximately 155°F/68°C internal temperature, and monitored until a final internal temperature of 160°F/71°C was attained. Chops were cooled on a wire rack for five minutes and the highest internal temperature attained during the standing period was recorded. After standing for five minutes, the weights of the chops were measured.

Roasting - Top loin, tenderloin and sirloin roasts were weighed raw and placed on a rack in a pan in order to keep samples out of the drippings. Boneless top loin roasts were roasted as "single" loin roasts (one loin muscle only). For products purchased as boneless double top loin roasts (i.e., two single top loin roasts backed and tied together), the strings were removed, and each half of the double top loin roast was processed as a single top loin roast. The roasts were cooked uncovered in a preheated oven at 425°F/218°C for tenderloin roast and 325°F/163°C for other roasts. Cooking temperature was monitored with an oven thermometer. Roasts were removed when they achieved an internal temperature of ~150°F/66°C; the target final internal temperature was approximately 160°F/71°C. Roasts were allowed to stand for 15 minutes and the final internal temperature was determined during this period. The cooked weight of each roast was determined and the cooking yield was calculated.

Roasting - Physical fat loosely attached to the raw spareribs was removed before cooking. The raw weight of the spareribs was obtained after the loosely attached fat was removed. The number of ribs in each product being cooked was recorded. Spareribs were placed on a rack in a pan, and were not covered during cooking. Ribs were roasted in a preheated 325°F/163°C oven for 1 hour and 45 minutes. Ribs were then removed from the oven; the temperature in the intercostal muscles was immediately taken. Ribs were cooled for 10 minutes, and then re-weighed. When cool enough to process, the edible lean tissue was separated from bone and cartilage. The weight of bone and cartilage was recorded as refuse. Separable fat and connective tissue are not considered refuse in cooked ribs since it is assumed that for this product, all soft tissues are consumed.

Braising - The raw shoulder blade steaks and country-style ribs were weighed. The thickness of the external fat around the outer surface of the cuts was measured. The samples were placed on a rack in a roasting pan. Distilled water (100 ml) was added to the roasting pan, which was covered tightly and placed in the center of a preheated 325°F/163°C oven. Cooking time was determined from initial trials. Initial cooking time

estimates were 45 minutes for blade steaks; 1 hour and 15 minutes for country-style ribs. The internal temperature was determined with an electronic digital thermometer. Steaks and/or ribs were allowed to cool for five minutes, then re-weighed, and each weight was recorded.

Nutrient Analysis: Nutrient analyses of moisture and total fat are described above in the Ground Beef Study section of this report.

Cured Ham Study

A study was conducted by USDA in collaboration with the University of Wisconsin to update the nutrient profiles of various cured ham products in SR.

The word "ham" refers to meat from the hind leg of a hog. Cured hams sold in the U.S. are classified into four categories according to the USDA Food Safety and Inspection Service (2013a):

- Ham - at least 20.5% protein in the lean area;
- Ham with Natural Juices (HNJ) – at least 18.5% protein;
- Ham, Water added (HWA) - at least 17% protein with 10% added solution;
- Ham and Water Product (HWP) - contains more water than 'Ham, water added'; labeling must indicate percent of "added ingredients".

Added ingredients may vary for each product. These solutions, flavorings or "added ingredients" which provide flavor enhancement may include water, sugar, salt, sodium erythorbate, sodium nitrite, potassium, and magnesium. Binders such as soy or milk proteins may also be added to help hold water in the product.

Sampling and sample preparation: The sampling plan used for the study was developed for the National Food and Nutrient Analysis Program (Pehrsson et al., 2000). The country was divided into four regions, with three consolidated metropolitan statistical areas (CMSA) within each region. Two retail stores were selected within each CMSA. Eight different types (categories) of products were picked up from 12 retail outlets nationwide per the sampling plan. The products were:

- Ham: bone-in whole; bone-in shank half
- Ham with natural juices: bone-in rump; bone-in butt half; spiral sliced
- Ham, water added: bone-in slice; boneless (many shapes and sizes)
- Ham and water product: boneless slice

Three branded hams were selected in pairs for the purpose of these yield studies. The sampling procedure for each category of bone-in hams was to obtain two half hams at each retail outlet. One was a shank half portion and the other was a rump half portion. All products were vacuum-packaged, individually labeled, and sent frozen to University of Wisconsin for further cooking and dissection. Hams were weighed, measured for thickness and dissected to separate external fat and seam fat. Bone-in hams were further

dissected for removal of bone and connective tissue prior to nutrient analyses. Branded hams or paired bone-in whole hams were cut into shank, butt and slices.

Cooking procedure: One portion type from each pair was analyzed as purchased and the other roasted to an internal temperature of 160°F/71°C for rumps and shanks. Slices were weighed and measured for thickness prior to being pan-fried to an internal temperature of 160°F/71°C. All other types of bone-in and boneless hams were either roasted in a 325°F/163°C convection oven, or pan-broiled and cooked to the internal temperature specified on the label. Samples were weighed after heating and weights were recorded.

Nutrient analysis: Nutrient analyses of moisture and total fat are described above in the Ground Beef Study section of this report.

Enhanced Pork Study

A collaborative study was conducted by scientists at NDL, University of Wisconsin, and the National Pork Board to determine the nutrient profile of the following enhanced pork products: shoulder-blade steak, tenderloin, and top loin chops. Enhanced meat and poultry products are defined by the USDA Food Safety and Inspection Service as "raw products that contain flavor solutions added through marinating, needle injecting, soaking, etc." (USDA, FSIS, 2013b).

Sampling: The fresh enhanced pork cuts were pre-ordered and purchased from 12 retail outlets using the nationwide sampling plan developed for the USDA National Food and Nutrient Analysis Program (NFNAP) (Perry et al., 2003) and shipped frozen to the University of Wisconsin for trimming and preparation.

Cooking procedures and nutrient analysis: Cooking procedures and nutrient analyses were similar to those for the Natural Fresh Pork Study described above.

Pork Value Cuts Study

The National Pork Board in collaboration with USDA and University of Wisconsin conducted a study to determine the nutrient profile of 4 new pork cuts. These cuts, collectively referred to as Pork Value Cuts, are single muscle cuts derived from the shoulder and the leg. The common names, scientific names of the muscle, and primal source of the cuts are as follows:

- Shoulder Breast Boneless (Pectoralis profundi), from the shoulder;
- Shoulder Petite Tender Boneless (Teres major), from the shoulder;
- Leg Cap Steak Boneless (Gracilis), from the leg;
- Leg Sirloin Tip Roast Boneless (Vastuslateralis and Rectus femoris), from the knuckle and leg.

Sampling: A total of 14 paired cuts for each pork value cut were obtained from pork production plants in North Carolina and Iowa. At each plant, both shoulder and hams from seven randomly selected pork carcasses were obtained. Each muscle was denuded, trimmed free of all external fat and connective tissue and frozen prior to shipment to the University of Wisconsin.

Sample preparation: Among the seven paired products from each of the two locations, six pairs were randomly selected for use in the study. One member of each pair was prepared as a raw sample and the other was cooked either by broiling or braising to a desired internal temperature or time endpoint. After a cooling period of five minutes, the cooked product was cubed, hand mixed and divided into individual carcass samples, composites of two carcasses or composites of three carcasses.

Cooking procedures:
Broiling - Weights of the raw shoulder breast, shoulder petite tender, and leg cap steak cuts were obtained. Two thermocouples were placed into one or two cuts, as needed. Cuts were grilled on a preheated George Foreman™ Indoor/Outdoor Electric Barbeque Grill for 10 minutes on setting "4". Cuts were turned over when the internal temperature reached 100-105°F/38-40°C. Cuts were removed from the grill at approximately 155°F/68°C internal temperature to attain a final target internal temperature of 160°F/71°C. After standing for five minutes, cuts were re-weighed and the highest internal temperature attained during the standing period was recorded.

Braising - The raw leg sirloin tip roast cuts were weighed and placed on a rack in a roasting pan. Distilled water (100 ml) was added to the roasting pan, which was covered tightly and placed in the center of a preheated 325°F/163°C oven. Cuts were braised until reasonably tender. Cooking time was determined from initial trials. Initial cooking time estimates were 45 minutes for blade steaks; 1 hour and 15 minutes for country-style ribs. Immediately after removal from the oven, the samples were placed on a wire rack. The internal temperature was determined with an electronic digital thermometer. Cuts were allowed to cool for five minutes and then weighed.

Nutrient analysis: Nutrient analyses of moisture and total fat are described above in the Ground Beef Study section of this report.

Ground Pork Study

New data on nutrient composition of ground pork products available in the U.S. retail market were needed to update SR and to support nutritional intake studies of the population. The USDA, in collaboration with the National Pork Board and Texas Tech University, undertook this collaborative study to determine the mathematical relationship between individual nutrients and fat content of raw ground pork using mixed model regression analysis.

Sampling: Samples were obtained from each of the four U.S. commercial packers of

this product (Smithfield, Premium Standard Farms, Farmland, and Johnsonville). These samples were formulated by the packer to provide the following fat levels: low fat (2-6% fat; four individual samples per packer except two from Smithfield), medium fat (14-17% fat; four individual samples per packer) and high fat (26-30% fat; four individual samples per packer). Samples from each packer from each fat level were divided into aliquots for preparations as raw products, pan-broiled patties, and pan-browned crumbles.

Sample preparation: For patties, approximately 112 grams of ground pork were selected from each packer's sample, weighed, and blended in 20 rotations manually in a Hobart mixer for two minutes. Patties were formed by pressing them in a patty mold. For the crumble samples, approximately 224 grams of ground pork were weighed and blended using 20 rotations manually in a Hobart mixer for two minutes.

Cooking procedures:
Pan-broiling - Ground pork patties: Patties were grilled for 13 to 15 minutes on a West Bend electric skillet preheated to 400°F/204°C, turning once, and removed from the pan when the internal temperature reached 165°F/74°C. Patties were allowed to cool for five minutes. Weights were determined prior to cooking and after cooling; cooking yields were calculated from these weights. When cool, the patties were cut in half to evaluate degree of doneness.

Pan-browning - Ground pork crumbles: First, patties were formed by hand by pressing them in a patty mold. Three to four patties were placed on a preheated 400°F/204°C West Bend electric skillet and pan-browned for five minutes. Patties were broken apart with a silicon turner while browning to form the crumbles and removed from the pan when the internal temperature reached 165°F/74°C. Crumbles were drained in a colander to remove excess fat. Crumbles were allowed to cool at room temperature for five minutes. Pre- and post- cooking weights were determined and cooking yields calculated. When cool, crumbles were placed into labeled clean unsealed vacuum bags and stored in the cooler at 37°F/3°C.

Nutrient Analysis: Nutrient analyses of moisture and total fat are described above in the Ground Beef Study section of this report.

Pork Loin Study

A study was conducted in collaboration with the USDA Nutrient Data Laboratory and scientists at Texas Tech University and the National Pork Board to determine the nutrient composition of 24 fresh pork cuts. The cuts chosen for evaluation were: Blade Chops/Roast (bone-in and boneless), Center Loin Chops/Roast (bone-in and boneless), Center Rib Chops/Roast (bone-in and boneless), Country Style Ribs, Sirloin Chops/Roast (bone-in and boneless), Top Loin Chops/Roast (boneless), Baby Back Ribs, Shoulder Arm Picnic, Rump Half, and Shank Half.

Sampling: Twenty-four fresh pork cuts were pre-ordered and purchased from 12 retail outlets following the nationwide sampling plan developed for the USDA National Food and Nutrient Analysis Program (Perry et al., 2003). Samples were shipped frozen to Texas Tech University for trimming and preparation. Products from each location were assigned randomly to either raw or cooked preparation.

Cooking Procedures:

Braising - The raw blade steaks and/or country-style ribs were weighed and the weights were recorded. Blade steaks or country style ribs were placed on a rack in a roasting pan. Distilled water (100 ml) was added to the roasting pan, which was tightly covered and placed in the center of a preheated 325°F/163°C oven. Cooking time was determined from initial trials. Initial cooking time estimates were 45 minutes for blade steaks; 1 hour and 15 minutes for country-style ribs. The internal temperature was determined with an electronic digital thermometer. Steaks and/or ribs were allowed to cool for five minutes and then re-weighed and weights were recorded.

Broiling - Weights of the raw cuts were obtained and recorded. Cuts were grilled on a preheated George Foreman™ Indoor/Outdoor Electric Barbeque Grill for ten minutes on setting "4". Two thermocouples were placed into one or two cuts, as needed. Cuts were turned over when the internal temperature reached 100-105°F/38-40°C. Cuts were removed from the grill at approximately 155°F/68°C internal temperature to attain a final target internal temperature of 160°F/71°C. After standing for five minutes, cuts were re-weighed and the highest internal temperature attained during the standing period was recorded.

Roasting - Top loin and sirloin roasts were weighed raw and weights were recorded. Roasts were placed on a rack in a pan to keep samples out of the drippings. Boneless top loin roasts were roasted as "single" loin roasts (one loin muscle only). For products purchased as boneless double top loin roasts (i.e., two single top loin roasts backed and tied together), the strings were removed, and each half of the double top loin roast was processed as a single top loin roast. The roasts were cooked uncovered in a preheated 425°F/218°C oven. Cooking temperature was monitored with an oven thermometer. Roasts were removed when they achieved an internal temperature of ~150°F/66°C; the target final internal temperature was approximately 160°F/71°C. Roasts were allowed to stand for 15 minutes and the final internal temperature was determined during this period. The cooked weight of each roast was determined and the cooking yield was calculated.

Pan-frying - Center loin chops, center rib chops, top loin chops and blade chops were thawed, weighed raw, placed on a electric skillet preheated to 350°F/177°C, and monitored with a thermocouple. The samples were pan-fried for six to eight minutes, turning once and removed from heat when the internal temperature reached 175°F/79°C. After samples were placed on a paper towel to cool for five minutes, the final internal temperature was then measured and samples were re-weighed approximately three minutes later.

Nutrient Analysis: Moisture and fat analyses have been previously described in the Ground Beef Study section of this report.

Variety Meats Study

In collaboration with the University of Wisconsin, the USDA conducted a study to determine the nutrient composition of variety meat products. Products analyzed consisted of beef brain, beef heart, beef kidney, and beef tripe; chicken gizzards; turkey gizzard, turkey heart, turkey liver; pork chitterlings, pork feet, and pork stomach. Samples were cooked according to available recipes or package directions. In most cases, samples were analyzed raw and cooked. In cases where insufficient product was available, products were analyzed in cooked but not raw form.

A. Beef brain, heart, kidney, and tripe

Sampling: Samples of beef brain, heart, kidney, and tripe were obtained in Madison, Wisconsin, from a single store, meat purveyor, or production facility due to limited retail availability.

Sample preparation: One brain was obtained from a production facility. One half was analyzed raw, and the other half was analyzed cooked (simmered). Both halves were weighed before and after trimming and preparation. Refuse (including clots, bone fragments and brain stem) was weighed separately.

One heart was also obtained from a production facility. One half was analyzed raw, and the other half was analyzed cooked (simmered). Both halves were weighed before and after trimming and preparation. Refuse (fat, connective tissue, veins, arteries, tubes) was weighed separately.

Four kidneys were halved to form eight pieces. Four pieces were used in the raw sample and the remaining four were used in the cooked sample. The halves were weighed before and after trimming and preparation. Refuse (fat and tubes) was weighed separately.

Tripe (stomach lining) was procured from a retail store. Two packs of tripe were used in each raw sample and in each cooked sample (simmered). The tripe strips from the two packages were divided between the raw and cooked samples by alternating tripe pieces in each sample. There was no refuse.

Cooking procedure: Items were cooked according to recommended methods from household recipes. Recipes commonly required simmering. Each variety meat was simmered in the same manner.

Simmering - The brain sample was placed in a large stock pot and covered with deionized water. Water was brought to a boil, then the heat was lowered to simmer the product. The brain was simmered for 20 minutes to an internal temperature of 160°F/71°C using a meat thermometer. It was removed from the pot and drained on a

cooling rack for three minutes. While draining, the final internal temperature 185°F/ 85°C was recorded.

The heart was placed in a large stock pot and covered with deionized water. A lid was placed on the pot and the water was brought to a boil. The temperature was lowered and the heart was allowed to simmer for at least two hours to an internal temperature of 160°F/71°C. It was removed from the pot and drained on a cooling rack for three minutes. The final internal temperature (194°F/90°C) was measured with a meat thermometer.

Kidneys were placed in an electric fry pan set to 325°F/163°C and covered with deionized water. The pan was covered. Kidneys were brought to a boil on high heat. Temperature was lowered to 250°F/121°C and kidneys were simmered for one hour to an internal temperature of 160°F/71°C. Kidneys were then removed from the pan and drained on a cooling rack for three minutes.

Tripe was placed in an electric fry pan set to 375°F/190°C and covered with deionized water. The tripe was brought to a boil. The temperature was lowered and the tripe was simmered for two hours to an internal temperature of 160°F/71°C. It was drained on a cooling rack for three minutes. As product drained, a final internal temperature was determined (122°F/50°C through the thick part and 90°F/32°C through the thin part).

Nutrient analysis: Nutrient analyses of moisture and total fat are described above in the Ground Beef Study section of this report.

B. Chicken gizzards

Sampling and sample preparation: Gizzard is a thick-walled muscular sac in the digestive tract of poultry. Gizzard samples were obtained locally from a retail store. After separating the hearts from the gizzards, raw samples were weighed.

Cooking procedure: Gizzards were placed in an electric fry pan with deionized water and simmered for 15 minutes. They were removed from the pan and placed in another pan with a small amount of deionized water. The pan was covered and the gizzards were braised for 20 minutes to an internal temperature of 160°F/71°C. The product was removed from the pan and drained on a cooling rack. The internal temperature of 136°F/58°C was determined with a meat thermometer. Samples were weighed before and after preparation and weights were recorded.

Nutrient analysis: Gizzards were analyzed both raw and cooked. Nutrient analyses of moisture and total fat are described above in the Ground Beef Study section of this report.

C. Turkey gizzard, heart, and liver

Sampling: Samples were obtained locally from a single store or production facility.

Sample preparation: Turkey gizzards, heart, and livers were prepared for analyses. For each of these products, ten samples were analyzed raw and ten were analyzed cooked (simmered). Samples were weighed before and after preparation.

Cooking procedure:
Simmering - Gizzards, hearts and livers were placed in an electric fry pan set to 300°F/149°C with a small amount of deionized water. This was brought to a boil, at which time the heat was lowered and the samples were simmered for 25 minutes for gizzards and livers, 15 minutes for hearts, to an internal temperature of 160°F/71°C. After simmering, samples were removed and placed on a cooling rack to drain. While draining, the final internal temperature 185°F/85°C was taken.

Nutrient analysis: Samples were analyzed for moisture and total fat as previously described in the Ground Beef Study section of this report.

D. Pork chitterlings, feet, and stomach

Sampling: Samples were obtained locally from a single store or production facility. Ten pounds of pork chitterlings (intestines) were obtained from a local store. Pork feet were initially obtained from a local store. Due to the need for more samples, four more pork feet were obtained from a local production facility. Pork stomach was also obtained from a local store. Two packages, each containing two stomachs, were obtained.

Sample preparation: Five pounds of chitterlings were analyzed raw and five pounds were analyzed cooked (simmered). Both samples were weighed before and after trimming and preparation. Refuse (waste matter and fat) was weighed separately.

Pork feet were chosen randomly from the two packages and from the product obtained from the four production facilities. One set of feet were analyzed raw and the other set of feet were analyzed cooked (simmered). Two pork stomachs were analyzed raw and two were analyzed cooked (simmered).

Cooking procedures:
Simmering - Chitterlings were placed in an electric fry pan and covered with deionized water. They were covered with a lid and brought to a boil. The temperature was lowered and the chitterlings were simmered for two hours to an internal temperature of 160°F/71°C. They were removed from the pan to drain on a cooling rack. As the product drained, the final internal temperature of 133°F/56°C was recorded.

Pig feet were placed in a large stock pot and covered with deionized water. The pot was brought to a boil at which time the heat was lowered. The pig feet were simmered for three hours to an internal temperature of 160°F/71°C and until the skin was split from the bone. The feet were removed from the pot to drain on a cooling rack for three minutes. At this time the final internal temperature (205°F/96°C through skin and 173°F/78°C

through exposed meat) was determined. Both sets of samples were weighed before and after trimming and preparation. Refuse (bone, tendons, and connective tissue) was weighed separately.

Stomachs were placed in an electric fry pan and covered with deionized water. Water was brought to a boil and then the temperature was lowered. The stomachs were simmered for 2 hours and 20 minutes to an internal temperature of 160°F/71°C. They were then removed from the pan. Due to increased water absorption, samples were drained for five minutes. Final internal temperature (140°F/60°C through hollow and 190°F/88°C through muscle) was taken while draining. The samples were weighed before and after preparation.

Nutrient analysis: Samples were analyzed for moisture and total fat as previously described in the Ground Beef Study section of this report.

Pork Sausage Study

Sampling and sample preparation: Sausages were sampled from four different locations nationwide (designated West, Midwest, East, and South).
West - three types of sausages were sampled: extruded (without casing) links, regular diameter (with casing) links, and larger diameter (with casing) links.
Midwest - two types of sausages were sampled: patties and regular diameter (with casing) links.
East - one type of sausage was sampled: regular diameter (with casing) links.
South - three types of sausages were sampled: extruded (without casing) links, patties, and regular diameter (with casing) links.

Cooking procedures:
West - Sausage links were placed on an electric griddle preheated to 325°F/163°C and pan-fried without added oil according to package directions, for 25 minutes to an internal temperature of 160°F/71°C. Extruded sausages were cooked for 11 minutes, regular diameter sausages were cooked for 13 minutes, and larger diameter sausages were cooked for 20 minutes. All types were cooked separately.
Midwest - Sausages were placed on an electric griddle preheated to 300°F/149°C and pan-fried without added oil according to package directions. Patties were cooked for 10 minutes and regular links for 16 minutes and 30 seconds until internal temperature reached 160°F/71°C. All types were cooked separately.
East - Sausage links were placed on an electric griddle preheated to 300°F/149°C and pan-fried without added oil according to package directions. Links were cooked for 25 minutes until internal temperature reached 160°F/71°C.
South - Sausages were placed on an electric griddle preheated to 300°F/149°C and pan-fried without added oil according to package directions. Extruded sausages were cooked for 10 minutes, patties were cooked for 15 minutes, and regular diameter links were cooked for 20 minutes. Sausages were cooked until internal temperature reached 160°F/71°C. All types were cooked separately.

After cooking, samples were removed from the griddle and placed on a cooling rack, when the final internal temperature of 160°F/71°C was determined with a meat thermometer. Samples were weighed after cooking and weights were recorded.

Nutrient analysis: All samples (both raw and cooked) were analyzed for moisture and total fat as previously described in the Ground Beef Study section of this report.

Turkey Sausage Study

Sampling and sample preparation: Two chubs of sausage were obtained from a single store in Madison, Wisconsin. Chubs were cut into equal halves then portioned so that each chub yielded eight equal patties. Alternate patties from each chub were analyzed raw and cooked (pan-fried). Patties from both chubs were weighed before and after preparation.

Cooking procedure: Sausage patties were placed on an electric griddle preheated to 325°F/163°C and pan-fried without added oil according to package directions, for 25 minutes to an internal temperature of 181°F/83°C. Samples were removed from the griddle and placed on a cooling rack, when the final internal temperature of 181°F/83°C was determined with a meat thermometer. Samples were weighed after cooking and weights were recorded.

Nutrient analysis: Samples (both raw and cooked) were analyzed for moisture and total fat as previously described in the Ground Beef Study section of this report.

Chicken Drumsticks & Thighs Study

USDA conducted a study in collaboration with Texas Tech University to determine the nutrient composition of raw and cooked chicken drumsticks and thighs sold as retail parts, for inclusion in SR.

Sampling: Samples of non-enhanced dark meat chicken (n=7) and enhanced (n=7) were procured from 12 retail locations, using the nationwide sampling plan developed for the USDA's National Food and Nutrient Analysis Program (Perry et al., 2003). Weights of meat, skin, and other components, both raw and cooked, were obtained in order to determine cooking yields. Samples of meat and skin were homogenized separately, composited, and chemically analyzed for nutrient content.

Cooking Procedures:
Roasting - Drumsticks and thighs were placed on a wire rack in a shallow roasting pan, with no water added to the pan. Samples were roasted, uncovered, in preheated

350°F/176°C oven to an internal temperature of 165°F/74°C, then removed from the oven. After 30 minutes at room temperature, cooked weights were obtained.
Braising - Oven was preheated to 325°F/163°C. Distilled water (100 ml) was added to the roasting pan, samples were added, pan was covered tightly and placed in the center of the oven. Cooking time was determined from initial trials. Initial cooking time estimates were 45 minutes. After removal from oven, drumsticks and thighs were allowed to cool for 5 minutes and then re-weighed; weights were recorded.

Sample preparation: After weighing, the drumsticks and thighs were refrigerated for up to 24 hours. Dissection of each was performed by carefully scraping the co-mingled parts with a knife blade, so that the separable fat, bone, and cartilage were separated from the meat as closely as possible, then each component was weighed.

Nutrient analysis: Moisture and fat analyses have been previously described in the Ground Beef Study section of this report.

Whole Turkey Study

USDA conducted a study in collaboration with Texas Tech University to determine the nutrient composition of raw and roasted whole turkey for inclusion in the SR. The study was initiated due to changes occurring in the industry. For example, during sampling and market checks done by the Nutrient Data Laboratory, most whole turkeys found in retail outlets were labeled with sodium-containing solutions, while non-enhanced whole turkeys were relatively uncommon.

Sampling: Samples of whole enhanced turkeys were procured from 11 retail locations, using the nationwide sampling plan developed for the USDA's National Food and Nutrient Analysis Program (NFNAP) (Perry et al., 2003). Due to unavailability of non-enhanced turkeys in the NFNAP retail locations, samples of non-enhanced turkeys were obtained through 4 different local retail sources. Two turkeys per location were purchased—one to be dissected and analyzed raw and the other to be dissected and analyzed after roasting. Weights of meat, skin, and other components were obtained in order to determine cooking yields. Samples of meat, skin and offal (gizzard, heart, and liver) were homogenized, composited, and chemically analyzed for nutrient content.

Cooking Procedure: The weight of drippings, neck, organ meats, and packaging were measured. Turkeys were placed on a wire rack in a shallow roasting pan, with 1/2 cup water added in the bottom of the pan. Turkeys were roasted in preheated 325°F/163°C oven to an internal temperature of 165°F/74°C, when they were removed from the oven. After 20 minutes at room temperature, each whole turkey was weighed.

Sample preparation: Each turkey was cut into parts: breast, wings, drumsticks, thighs, and back including the tail. Each part was weighed and refrigerated for up to 24 hours. Dissection of each part was performed by carefully "scraping" the co-mingled parts with

a knife blade, so that the separable fat, bone, and cartilage were separated from the meat as closely as possible, and then weighed, to measure the amount of each component.

Nutrient analysis: Moisture and fat analyses have been previously described in the Ground Beef Study section of this report.

Turkey Retail Parts Study

USDA conducted a study in collaboration with Texas Tech University to determine the nutrient composition of raw and roasted retail turkey parts for inclusion in the SR.

Sampling and Sample Preparation: Samples of turkey drumsticks, thighs, breast, and wings were procured from 12 retail locations, using the nationwide sampling plan developed for the USDA's National Food and Nutrient Analysis Program (NFNAP). The parts in this study were not labeled as having been enhanced with sodium-containing solutions except for the breast, for which both enhanced and non-enhanced samples were procured. Weights of meat, skin, and other components, both raw and cooked, were obtained in order to determine cooking yields. Samples of meat and skin, both raw and cooked, were homogenized, composited, and chemically analyzed for nutrient content.

Cooking Procedure: The turkey parts were placed on a wire rack in a shallow roasting pan, with no water added to the pan. The parts were roasted, uncovered, in a preheated 350^{o}F/176°C oven to an internal temperature of 165^{o}F/74°C, when they were removed from the oven. After 30 minutes at room temperature, the cooked weights were obtained.

Sample preparation: Dissection of each turkey part was performed by carefully scraping the co-mingled parts with a knife blade, so that the separable fat, bone, and cartilage were separated from the meat as closely as possible then weighed, to measure the amount of each component.

Nutrient analysis: Moisture and fat analyses have been previously described in the Ground Beef Study section of this report.

Veal Retail Cuts Study

USDA conducted a study with Colorado State University (CSU) to obtain nutrient and composition data for representative retail veal cuts for inclusion in SR. The cuts included: loin chops and roast, shoulder blade chops, and cutlets.

Sampling and Sample Preparation: Retail cuts were obtained from the six major U.S. establishments which conduct their own slaughter of special fed (non-bob veal) U.S. calves. The locations were Greeley CO, Collingswood NJ, Detroit MI, Harleysville PA, Franklin WI, and Vineland NJ. Raw and cooked samples (n=6 per cut) were dissected using standard protocols and then homogenized, composited, and analyzed. Weights of

component factors for each cut, such as separable lean, separable fat, and bone and connective tissue, were determined.

Cooking procedure: A Salton two-sided electric grill was preheated to 383°F/195°C. Samples were evenly spaced on the grill surface. Different types of cuts were cooked on separate grills. Due to thinness of the cutlets, they were flipped after one minute and cooked for approximately 2.5 minutes or to internal temperature of 158°F/70°C. The loin chops and blade chops were flipped after four minutes or when the internal temperature reached 95°F/35°C to ensure even cooking. Chops were removed from the grill when internal temperature of 158°F/70°C was obtained. Final internal temperature and cooked weight (to nearest 0.1 gram) were recorded. All samples after cooking were immediately placed on wire racks and chilled uncovered (36-39°F/2-4°C) for at least 12 hours before dissection.

Nutrient analysis: Moisture and fat analyses have been previously described in the Ground Beef Study section of this report.

3. Format of USDA Table of Cooking Yields for Meat and Poultry

TABLE HEADINGS:

- Food Group Code: Code number which can be used to identify item by type
    - 05 – Poultry Products
    - 07 – Sausages and Luncheon Meats
    - 10 – Pork Products
    - 13 – Beef Products
    - 17 – Lamb, Veal, and Game
- NDB number: 5-Digit Nutrient Databank number corresponding to the SR code number most closely associated with the related yield information. In some cases, the SR description will not be identical to the yield description. For listings which represent a generic group of retail cuts, an NDB number cannot be provided.
- Yield Description: Description of food represented in the yield data.
- Preparation Method: Cooking method used, such as braised, broiled, roasted. In some cases, similar cooking methods may be grouped together (i.e., broiled and grilled).
- Cooking Yield %: Percent change in weight of a product due to cooking. For calculating yield, see equation on page 5.
- n: Number of samples used in calculating values for this table.
- SD: Standard deviation of the mean; null if could not be calculated (i.e, n<3).
- Yield Minimum %: Minimum yield % in the data set.
- Yield Maximum %: Maximum yield % in the data set.
- Moisture Gain/Loss %: Percent change in amount of moisture in a product due to cooking. For the calculation used, see equation on page 5.
- Fat Gain/Loss %: Percent change in amount of fat in a product due to cooking. For the calculation used, see equation on page 5.

- Release Year: Most recent year for which the nutrient data for the item were made available in SR. Listings shown with a 1975 release year are based on data for items contained in AH-102 Food Yields: Summarized by Different Stages of Preparation.

Notes Regarding Specific Data within the Table

Moisture Gain/Loss and Fat Gain/Loss: Data for these factors are not provided for some items, such as listings which represent a generic group of retail cuts, or where analytical nutrient values could not be obtained.

4. Glossary

Food Components

Edible portion	The part of the food product that can be eaten after trimming and removing non-edible components such as bone and connective tissue.
Refuse	Non-edible components such as bone and connective tissue. The separable fat may also be considered refuse when the food item description in SR includes the term "separable lean only".
Separable lean	Muscle tissue that remains after removing separable fat. This includes fat striations within the muscle (marbling).
Separable fat	Any outer trim fat and fat between muscle seams that can be readily separated from the muscle tissue.

Preparation Methods

Baked or Roasted	Food cooked in an oven, thereby surrounding it with dry heat.
Braised	Food cooked on top of the range or in the oven, tightly covered in a small amount of liquid at low heat for a lengthy period of time.
Broiled or Grilled	Food cooked directly under or above the heat source. Food can be broiled in oven under the gas or electric heat source, or grilled directly over charcoal or other heat source. The term barbecued is often used synonymously with grilled.
Dry heat	Any cooking procedure that does not include the use of a liquid, e.g., bake, roast and broil.
Fried in deep fat	Food immersed in hot fat deep enough to completely cover the food being cooked. Average fat temperature for deep-frying is

	375°F/190°C but recipes differ according to the characteristics of each food.
Microwaved	Food heated or cooked using an oven that produces high-frequency electromagnetic radiation as the heat source.
Moist heat	Any cooking procedure that involves the use of liquid.
Pan-broiled	Food cooked in uncovered skillet or frying pan over direct heat, using little or no fat. Drippings are poured off as they form.
Pan-browned	Cooking in uncovered skillet or frying pan over direct heat to obtain a brown surface on the food.
Pan-fried, Sautéed or Stir-fried	Food cooked in fat which does not cover the food. Sautéed is often thought of as using less fat and being faster than pan frying. Stir-frying is quickly cooking small pieces of food in a large pan with a minimum amount of fat, over very high heat while constantly stirring.
Poached, Simmered or Stewed	Food cooked in liquid at a temperature low enough that tiny bubbles just begin to break the surface (~185°F/85°C). A food being stewed involves simmering for a long period of time in a tightly covered pot.
Raw	Food item in its natural state: not processed, refined, or cooked.
Thawed	Introducing frozen food to a temperature higher than freezing so that it will defrost and become a liquid or softened state.

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