Journal of Food Protection, Vol. 70, No. 1, 2007, Pages 251–260

Supplement

Response to the Questions Posed by the Food Safety and Inspection Service Regarding Consumer Guidelines for the Safe Cooking of Poultry Products†

ADOPTED 24 MARCH 2006, ARLINGTON, VA.
NATIONAL ADVISORY COMMITTEE ON MICROBIOLOGICAL CRITERIA FOR FOODS

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MS 06-340: Received 20 June 2006/Accepted 2 August 2006

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EXECUTIVE SUMMARY

The National Advisory Committee on Microbiological Criteria for Foods (NACMCF, or the Committee) was asked to provide advice on developing guidelines for consumers for the safe cooking of poultry products. The questions were generated in response to foodborne illnesses from *Salmonella* related to the consumption of processed chicken products that appeared to be ready to eat (RTE) but contained poultry that was not ready to eat (NRTE).

The purpose of this document is to address the questions posed to the Committee by the U.S. Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS). In so doing, the Committee will provide guidelines to consumers for the preparation of poultry products to ensure that they are microbiologically safe. The document also will furnish information to food processors (i.e., any regulated entity such as federally or state inspected establishments) on product labeling that clearly states if the product is RTE or NRTE and provides validated cooking instructions that minimize consumer confusion.

To address this request, the Committee reviewed the advantages and limitations of the various types of processes used in cooking. The Committee also examined current labeling practices for NRTE and RTE products and the effect of those practices on the preparation of a microbiologically safe product. Information from an investigation of reports of salmonellosis in Minnesota and Michigan due to consumption of stuffed-chicken products, with a focus on labeling and retail product appearance, was also examined.

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† Sponsored by the U.S. Department of Agriculture, Food Safety and Inspection Service; U.S. Department of Health and Human Services, Food and Drug Administration, and Centers for Disease Control and Prevention; U.S. Department of Commerce, National Marine Fisheries Service; and U.S. Department of Defense, Veterinary Service Activity.

The Committee determined that guidance for consumers is needed on cooking poultry products to achieve an adequate lethality for pathogenic bacteria commonly associated with poultry and on interpreting the package labeling and cooking instructions. The delivery of an adequate lethality to the product is affected by the product composition and geometry, temperature before cooking, and crust formation. The guidance also must address proper use of thermometers by the consumer and how to determine if the thermometer is working properly. The guidance should also describe the calibration of thermometers used by consumers and provide them with an understanding of the method for calibrating and the reason for calibrating.

The recommendations of the Committee are based on the seven questions posed by the FSIS. A general summary of the recommendations, some of which are directed to the consumer and others to the food processor, follows.

Consumer.

- A single minimum internal product endpoint temperature of 165°F for cooking without a time limitation should be recommended to the consumer to ensure the microbiological safety of cooked poultry. This temperature will destroy *Salmonella,* the most heat-resistant pathogen of public health concern in raw poultry.
- Guidance to the consumer should indicate that higher final temperatures may be needed for consumer acceptability and palatability (e.g., 170°F for whole muscle breast meat, 180°F for whole muscle thigh meat in order to eliminate the pink appearance and rubbery texture).
- The product condition or state before cooking should be considered in the guidelines and in the preparation-cooking instructions to the consumer.
- Guidelines for the consumer should convey that a longer cooking time is needed if the product is frozen at the beginning of the cooking process. The consumer should also be informed that microwaving raw product from the frozen state is not advisable unless the package provides substantial further instructions for ascertaining that the product has achieved the recommended endpoint temperature.
- Guidance to the consumer should address how to properly measure product temperature. Instructions on how to calibrate the thermometer and on how to determine if it is out of calibration should be included, as well as a description of the purpose and importance of calibration.

Food processor.

- The product label should indicate if the product is RTE or NRTE. A warning on the label to fully cook a product may be necessary if the product is partially cooked or otherwise appears to be RTE. The principal display panel should be the primary focus for certain safety information (e.g., that the product contains uncooked poultry and must be cooked thoroughly for microbiological safety).
- When validating cooking instructions and developing guidelines or labeling, the process must take into account (i) how the consumer is likely to interpret the cooking instructions and (ii) how the consumer may actually prepare and cook the product. The cooking process must be designed to eliminate *Salmonella,* which is the most heat-resistant pathogen of public health concern for raw poultry. (Although *Listeria monocytogenes* is more heat resistant, it is considered a hazard from postprocess contamination rather than undercooking.)
- The limitations of each type of process should be considered when developing and validating cooking guidelines or instructions. The limitations include difficulty of temperature measurement, uneven heating, equipment differences, a partially cooked surface that may appear as if the product is fully cooked, and the potential for having a cooked surface with an undercooked product interior.
- When a product containing uncooked poultry appears to be cooked, it is necessary to explicitly state on the label that the product contains uncooked poultry and must be thoroughly cooked.

I. ORIGINAL WORK CHARGE AND BACKGROUND

Background and work charge. NRTE poultry products, including products that may be encased in a batter that has been subjected to heat in order to impart a cooked color and to set the batter, may be contaminated with pathogens. Cooking instructions for NRTE poultry products may not be validated for safety to fully address the intended use or the method of cooking by the consumer. Safety-based labeling messages guiding consumers may not adequately convey critical food safety preparation information. In addition, the current government guidance on safe cooking of poultry may not fully encompass new science associated with the pathogens or the levels of pathogens on consumer-ready products. Consumers need clear guidance to know what time-temperature needs to be attained during cooking to ensure safe poultry products.

The primary microbiological pathogens of concern include *Salmonella* strains, but others, including *L. monocytogenes,* may need to be considered.

Charge to the subcommittee. The charge to the subcommittee is to determine the minimal requirements for achieving microbiologically safe cooked poultry and associated methods for objective measurement. The subcommittee should assess all pathogens of concern and poultry cooking methods that may be used by consumers. The information developed by the subcommittee will be used by the FSIS to develop consumer messages on the cooking parameters necessary to ensure the safety of poultry.

The questions to be addressed are

1. What are the limitations in various cooking methods, particularly microwaving, that may need to be conveyed through labeling and other means to ensure that poultry cooked by consumers is safe?
2. Do cooking requirements differ by type of poultry (e.g., chicken versus turkey, whole carcasses versus parts, ground products with different levels of fat, raw versus partially cooked)?
3. What effect, if any, does the condition of poultry just

prior to cooking (e.g., chilled versus frozen) have on the cooking treatment?
4. What is the single time-temperature combination for each type of poultry (see question 2 above) for consumers to use to ensure safe cooked poultry?
5. What parameters should inspected establishments consider in developing validated cooking instructions for use by consumers?
6. Since consumers typically are not as capable of calibrating the cooking equipment and temperature measuring devices as inspected establishments, what, if any, special considerations should be considered in identification of safe cooking guidance for consumers (e.g., adding a safety margin to the minimum time-temperature)?
7. What safety-based labeling considerations should be considered for conveying safe cooking instructions to consumers?

Further background. In 2005, illnesses among consumers in the Michigan and Minnesota area (Appendix I) were associated with the consumption of various microwaveable poultry entrees that were NRTE but appeared to be RTE and were improperly cooked by the consumer. NRTE poultry products, including products that may be partially cooked or have a breaded or batter coating that was heated in order to impart a cooked color and set the batter, such as those involved in the illnesses, may be contaminated with pathogens. *Salmonella* Typhimurium and *Salmonella* Heidelberg were identified in the course of epidemiological investigations. In addition, in 2002, foodborne illnesses were associated with frozen chicken nuggets and strips contaminated with *Salmonella* Heidelberg *(5).* As in the Michigan and Minnesota cases, the products associated with the 2002 outbreak were parfried to lend a cooked appearance, although the meat was not fully cooked.

MacDougall et al. *(5)* also identified the cooked appearance and inadequate labeling as contributing to consumer confusion. These illnesses from both 2002 and 2005 prompted the FSIS to consider what actions the agency should take to decrease the chance of illness associated with the preparation of NRTE poultry products. Additional cases of salmonellosis due to *Salmonella* Enteritidis in Minnesota attributable to stuffed-chicken products have since been reported *(12).*

Product and package appearance and consumer interpretation of the labeling, cooking instructions, and safety-based information provided on the label may contribute to confusion by the consumer and subsequent inadequate preparation of the product. With regard to product appearance, batter-encased products that have been subjected to heat in order to impart a cooked color and set the batter may appear fully cooked to the consumer. Consequently, the consumer may only reheat the product for aesthetic or palatability purposes rather than subject it to cooking sufficient to kill pathogenic bacteria. Products that are NRTE may be packaged in containers, such as plastic trays, that are commonly associated with RTE microwaveable products. As a result, the consumer may only microwave the product for a time suitable for an RTE product. Similarly, the presence of both cooking and microwave instructions on the same package could cause the consumer to become confused as to the thoroughness of the cooking required. For example, microwave instructions on an NRTE product may be interpreted by the consumer to mean that the product just needs to be reheated and not fully cooked for microbiological safety. Also, safety-based labeling messages may not adequately convey critical food safety preparation information. Finally, cooking instructions for NRTE poultry products may not have been validated for microbiological safety to fully address the intended use or the method of cooking by the consumer. The cooking instructions must ensure that the minimum endpoint temperature is reached or must fully address the intended use or method of cooking by the consumer.

As with other methods of cooking, preparation of a food product in a microwave oven is influenced by the composition (e.g., moisture, density, ionic content), shape or geometry, and size of the product. In addition, the process is also dependent on the wattage and design of the microwave oven. A problem faced by commercial operations—difficulty in applying heat uniformly—also affects home microwave ovens *(2).*

Currently, a variety of temperatures for cooking poultry are recommended to the consumer. Consumers need clear guidance to know what time and temperature must be attained during cooking to ensure microbiologically safe poultry products. The primary microbiological pathogen of concern is *Salmonella,* but others, including *Campylobacter,* may need to be considered.

II. INTRODUCTION

The FSIS published the final rule ''Performance Standards for the Production of Certain Meat and Poultry Products'' in 1999 *(9).* The lethality compliance guidelines in Appendix A of this final rule listed two temperatures for cooking poultry: 160°F (71.1°C) for uncured poultry and 155°F (68.3°C) for cured poultry. In 2000, at the request of the FSIS, the USDA Agricultural Research Service conducted a sophisticated study *(4)* that provided a range of processing times and temperatures specifically for chicken and turkey containing differing levels of fat. Time-temperature tables based on this study were published in a *Federal Register* notice *(10).* This information was primarily directed at food processors.

Information for consumers is available at the USDA Meat and Poultry Hotline by phone (888-674-6854) and on the Thermy page *(13)* of the Food Safety Education section of the FSIS Web site. On the Web site, the temperatures specified for cooking poultry are 180°F for whole poultry as measured in the thigh and wing pieces, 170°F for breasts, and 165°F for ground poultry. The temperatures recommended to consumers by the FSIS exceed those provided to food processors, because poultry pieces cooked to 160°F are generally unpalatable to the consumer because of the pink appearance and rubbery texture. For whole poultry, temperature measurement in a whole carcass wing joint, which is the slowest to heat, is difficult. A temperature

TABLE 1. *Comparison of methods to achieve safe cooking of poultry products*

Method	Advantages	Limitations	Other food safety concerns
Boiling (may include poaching)	Complete product surface contact with heating medium Generally product remains at lethal temperature for an extended time	Difficulty of taking internal product temperature while cooking	
Broiling (product under [below] an intense heat source)	Good surface lethality	Crust formation limits heat transfer Uneven heating	For electric ovens, door should remain ajar to prevent element from cycling off, resulting in undercooking
Deep fat frying (complete immersion in oil)	Complete product surface contact with heating medium Heat carryover (temperature continues to increase)	Oil temperature recovery may be slow when cooking frozen product Difficulty of taking internal product temperature while cooking Undercooking interior because exterior looks cooked	Undercooking is a bigger concern with larger products When frying outdoors, weather may affect cooking time
Pan frying	High temperature at heating surface	Uneven cooking Undercooking interior because exterior looks cooked	Lid on or off pan can influence cooking time and uniformity
Grilling	Good surface lethality	Crust formation limits heat transfer Nonuniform heat; weather may affect cooking time for outdoor grilling May not be feasible for very large whole carcasses (e.g., greater than 16 lb)	Greater chance of cross-contamination by utensils Inexperienced cooks may undercook product (if a thermometer is not used)
Simultaneous two-sided grilling	Better heat transfer than one-sided grilling	Large or thick product may not allow full closure of the equipment No temperature control	Placement of product may affect heat penetration Consumers may not have adequate guidance
Microwaving (refers to a microwave oven only, not to a microwave convection oven)	Faster come-up time resulting in less time in danger zone for bacterial growth Less potential for cross-contamination of products cooked in original package	Uneven heating Cooking is affected by: 1. Volume of product 2. Product characteristics (shape and composition) 3. Cooking container characteristics (material, shape, whether covered) 4. Product placement in the oven 5. Presence or absence of rotating carousel	Possible influence of other appliances on available power Differences in equipment make standardized cooking instructions difficult Inexperienced cooks (such as children) may not use appropriate settings Difficult to measure temperature while cooking Differences in wattage among ovens
Dry roasting or baking (baking and roasting are often used synonymously)	Generally product remains at lethal temperature for an extended time	Crust formation slows heat penetration Product shape may lead to uneven cooking	Influence of nonpoultry component (stuffing, breading, batter, casserole) on temperature profile
Wet roasting or baking (covered in or above liquid; includes cook-in-bag and foil wrap)	Generally product remains at lethal temperature for an extended time Crust formation, if it occurs, occurs after moist heat delivers adequate surface lethality	Product shape may lead to uneven cooking	Influence of nonpoultry component (stuffing, breading, batter, casserole) on temperature profile
Rotisserie	More even heat exposure than static processes Good surface lethality	Crust formation limits heat transfer	

TABLE 1. *Continued*

Method	Advantages	Limitations	Other food safety concerns
Slow cooker	Generally product remains at lethal temperature for an extended time	Frozen and large pieces of poultry remain in danger zone of microbial growth for longer time Slow come-up time at low temperature	Loss of heat when lid is lifted during cooking; takes a while for temperature to rise again
Smoking	Generally product remains at lethal temperature for an extended time	Difficult to determine doneness Difficult to control temperature Temperature and moisture drops when charcoal or wood is replenished (dependent on design of smoker) Weather may affect cooking time	Moisture is needed for adequate surface lethality Equipment and heat source variability make standardized cooking instructions difficult Remote digital thermometers can be used
Steaming (may include poaching)	Good heat penetration	Difficulty of taking internal product temperature while cooking Overcrowding of product may reduce heat transfer Ensuring adequate liquid	
Stewing and simmering	Generally product remains at lethal temperature for an extended time	Ensuring adequate liquid May take a long time	

greater than 160°F in the wing joint is achieved when the thigh reaches 180°F. These temperatures also provide a margin of safety, since cooking is generally less controlled in the home than in processing facilities.

Microwave cooking instructions on product labels usually list just the time for heating and holding and do not indicate a minimum endpoint temperature. Comparatively, labeling instructions for fully cooking a product in a conventional oven usually specify an endpoint temperature that can be considered instantaneous, i.e., no additional time at that temperature is required to produce a microbiologically safe product. Further, the size and geometry of the product may impact cooking temperatures. For a product with a large mass, the temperature may continue to increase after the endpoint temperature is reached and may remain at the endpoint temperature for some time after the product is removed from the heat source. In contrast, a product with a smaller mass probably will not remain at the specified temperature for more than a few seconds once removed from the heat source. This information on differences between heating large- and small-mass products does not appear to be adequately communicated to the consumer.

III. RESPONSE TO QUESTIONS IN THE CHARGE

1. What are the limitations in various cooking methods, particularly microwaving, that may need to be conveyed through labeling and other means to ensure that poultry cooked by consumers is safe?

Table 1 illustrates the advantages and limitations of various cooking methods for achieving a microbiologically safe product. A single minimum internal product endpoint temperature of 165°F for cooking without a time limitation is recommended to the consumer and can be achieved by any of the cooking methods listed in Table 1. For purposes of this document, the Committee is using definitions of cooking methods as accepted by various consumer cooking guides (e.g., *Food Lover's Companion (3)*). Issues regarding labeling, particularly with regard to microwaving, are addressed in the responses to later questions.

Canning and use of home pressure cookers, in addition to combination methods (e.g., convection microwave, grilling and steaming, heat treatment in combination with drying for jerky), were also discussed by the Committee. The Committee determined that these methods need not be addressed by the Committee for this charge because they usually are not listed by food processors on the product label as recommended methods of cooking.

2. [How] do cooking requirements differ by type of poultry (e.g., chicken versus turkey, whole carcasses versus parts, ground products with different levels of fat, raw versus partially cooked)? Please note that the Committee decided to add the word "how" to facilitate developing answers that would require more than a "yes" or "no" response.

The cooking requirements for achieving the desired internal product temperature for poultry will vary according to the size, geometry, degree of processing, and composition of the product (e.g., some products, such as cheese-stuffed chicken breasts, have more fat than whole muscle chicken). The FSIS time-temperature guidelines *(10)* issued to food processors for chicken and turkey are based on varying fat levels. With an increase in the level of fat, there is a concomitant increase in time at certain temperatures to

achieve the same lethality. The Committee agreed that the differences among poultry species are not significant enough to recommend to consumers different cooking temperatures for different species nor is there any justification for different temperatures for specific cuts of poultry for microbiological safety. Regardless of the type or size of product, the time and temperature for adequate lethality must be achieved in the part of the product that takes the longest to heat.

The cooking requirements recommended to consumers should achieve at least the same level of pathogen reduction required of food processors, i.e., a 7-log reduction of *Salmonella* (the level of lethality required in 9 CFR 318.150(a)(1)), should be the target level of reduction. A process sufficient to control *Salmonella* will also control *Campylobacter,* another pathogen of concern in poultry, e.g., a 7-log reduction process for *Salmonella* would achieve a greater than 50-log reduction of *Campylobacter* (Appendix II). Although *L. monocytogenes* is more heat resistant than *Salmonella,* it is considered a hazard from postprocess contamination rather than undercooking. Moreover, because a highly pathogenic strain of avian influenza type A virus (H5N1) has arisen as a concern in the international trade of poultry and poultry products *(6, 16, 18),* the Committee has determined, based on available data *(7, 8),* that a process that results in a 7-log reduction of *Salmonella,* whether applied by the food processor or the consumer, is adequate to destroy the avian influenza virus and other pathogens of likely concern in poultry, should they be present.

The Committee recommends that a single minimum internal product temperature of 165°F (74°C) with no required hold time be provided to the consumer to attain an acceptable level of food safety (see question 4). This temperature will reduce viable *Salmonella* by at least 7 log units. In addition, this temperature exceeds the 158°F (70°C) that is recommended to eliminate the avian influenza type A virus (H5N1) *(7, 18).* The FSIS time-temperature tables for cooking raw poultry products *(10)* show that a temperature of 165°F (74°C) and a hold time of less than 10 s for both chicken and turkey will achieve a 7-log reduction of *Salmonella.* The tables also note that the required lethality is achieved instantaneously for temperatures with a hold time of less than 10 s. At 165°F (74°C), there are no significant differences in achieving the required lethality with regard to different fat levels or species (chicken versus turkey). Therefore, the temperature recommended by the Committee for cooking poultry (165°F) provides a margin of safety against *Salmonella* and less heat-resistant pathogens such as avian influenza type A (H5N1) and *Campylobacter.*

In addition to the cooking temperature, guidance should be provided on the practical aspects of taking temperatures. This guidance should explain the reason for differences from previous FSIS recommendations and should illustrate different measurement scenarios. It should also indicate that higher temperatures may be needed for bone-in product to achieve consumer acceptability, as noted in question 4.

3. What effect, if any, does the condition of poultry just prior to cooking (e.g., chilled versus frozen) have on the cooking treatment?

The rate of heating and time required to reach the minimum endpoint temperature are affected by the degree of freezing (e.g., hard and crust frozen), whether the product is stuffed or breaded, the fat level, the water activity, the pH, the composition of marinades (with oil, sugar and salt, acid, and seasoning), whether the product is bone-in or boneless or is sectioned-and-formed or whole-muscle intact, and whether solution injection is applied. Food processors should consider these factors when developing and validating cooking instructions for NRTE products and heating instructions for RTE products (see question 5).

The Committee recommends that the principal display panel identify when NRTE poultry is contained in product that appears to be RTE (see question 7). Food processors should develop practical cooking instructions for the consumer. If the preparation and/or cooking instructions are overly complex, the consumer may not follow or understand them. When food processors include thawing in the cooking instructions, the product label should also provide thawing instructions that ensure microbiological safety, such as ''when defrosting in microwave, cook immediately after thawing.''

It is important that guidance to the consumer convey that a longer cooking time is needed for frozen product than for thawed product. The consumer should also be informed that microwaving raw product from the frozen state is not advisable unless the package provides substantial further instructions for ascertaining that the product has achieved the recommended endpoint temperature. Many NRTE products are frozen, and if they are to be cooked from the frozen state, the required cooking time is longer than that for the thawed product. In addition, refrigerated NRTE products may be frozen by the consumer for later use. If the recommended cooking time is based on thawed product, there should be guidance provided on how to ensure that the product is thoroughly and safely thawed. Thus, a minimum starting temperature for a thawed product may be appropriate. Regardless of the initial product temperature, a minimum internal temperature of 165°F must be reached before the product is microbiologically safe.

4. What is the single time-temperature combination for each type of poultry (see question 2 above) for consumers to use to ensure safe cooked poultry?

Because of reasons cited earlier, it would be difficult to develop a comprehensive list of poultry product types. Therefore, as noted in question 2 above, for consumers, the recommended minimum internal temperature of any poultry product is 165°F (74°C) with no required hold time. This single temperature for consumers provides an adequate safety margin to ensure that the poultry product is microbiologically safe. However, higher final temperatures may be needed for consumer acceptability and palatability (e.g., 170°F for whole muscle breast meat and 180°F for whole muscle thigh meat in order to eliminate the pink appearance

and rubbery texture). The Committee recommends that the FSIS continue to develop and distribute guidance for the consumer to explain temperatures that achieve perceived doneness versus those that achieve microbiological safety and why there is a distinction between the two. The Committee also recommends that any changes in consumer guidance be communicated in the FSIS ''Food Safety Educator'' newsletter *(14)* located on the FSIS Web site. For meat and poultry processors who operate within the hazard analysis and critical control point framework for ensuring safe food, a lower temperature than that recommended to consumers to deliver adequate lethality for an RTE product may be acceptable because of the additional control procedures.

5. What parameters should inspected establishments consider in developing validated cooking instructions for use by consumers?

The Committee acknowledges that most consumers do not own and/or use a meat thermometer, particularly when cooking convenience-type products. It is, therefore, important that cooking instructions be validated to ensure that the minimum internal temperature of 165°F will be achieved throughout the cooked product.

When designing validation studies, variability in the following areas needs to be considered.

- Consumer cooking device (e.g., differences in wattage of microwave ovens)
- Product (e.g., composition, size, shape, initial temperature, component distribution, age of product)
- Preparation practice (e.g., cooking vessel, punching holes in the package film, number of units to be cooked simultaneously, rotation of product during cooking cycle, appropriate product holding after the microwave process, location of product within the cooking device)
- Location at which internal temperature for poultry is taken in the product container

The appropriate validation study should at least consider conditions likely to result in the lowest temperature with regard to the above points. Preliminary studies can be used to determine the amount of variability in the process and the need for additional studies or the need to change the cooking instructions. If cooking instructions are changed for product quality reasons, the new instructions must be validated to ensure safety.

6. Since consumers typically are not as capable of calibrating the cooking equipment and temperature measuring devices as inspected establishments, what, if any, special considerations should be considered in identification of safe cooking guidance for consumers (e.g., adding a safety margin to the minimum time-temperature)? (Please note that the Committee interprets "equipment" to mean ovens, broilers, smokers, deep fryers, or other cooking devices.)

Since not all consumers are aware of the serious health hazards that can be associated with NRTE meat and poultry products, it is important that the FSIS remind consumers that products containing NRTE meat and poultry can pose serious health risks and that all NRTE meat and poultry products must be cooked to a proper internal temperature. The FSIS should continue to develop and distribute guidance to consumers on temperature measuring devices (e.g., dial or bimetallic-core thermometers and thermometers with thermocouples or thermistors).

The FSIS should also continue to proactively promote the purchase, proper use, and calibration of thermometers used to determine safe minimum internal cooking temperatures for NRTE meat and poultry. The FSIS should work to reach consumers in innovative and untapped ways through partnerships with schools, physicians, cooking shows, etc. The FSIS should seek sufficient funding to do a mass media campaign (e.g., ''Is It Done Yet?'' *(11)*) on a national basis, similar to the pilot program used in Michigan in August 2004 to educate consumers on the use of thermometers when cooking meat and poultry products. A mechanism for measuring the effectiveness of the campaign should be included.

The FSIS guidance should also explain the need for sanitary handling to prevent cross-contamination of RTE products and describe procedures for the safe storage and refrigeration of perishable products.

7. What safety-based labeling considerations should be considered for conveying safe cooking instructions to consumers?

The labeling on the package or container is critically important in conveying the correct message to the consumer, both for product preparation and cooking and for indicating whether the product is RTE or NRTE. Therefore, the principal display panel should be the primary focus for certain safety information and should clearly convey whether the product is RTE or NRTE. Some products, such as those covered with batter and heated to set the batter or those that are charmarked, may appear fully cooked when in fact they are not. When a product containing uncooked poultry appears to be cooked, it is necessary to explicitly state that the product contains uncooked poultry and must be thoroughly cooked.

The terminology used and its prominence on the principal display panel must be considered for distinguishing NRTE from RTE products. ''Ready-to-cook'' may not clearly inform the consumer that the product must be cooked to a minimum internal product temperature to kill pathogens. Consumers may not distinguish between the terms ''ready-to-cook'' (generally associated with an NRTE product) and ''ready-to-heat'' (generally associated with an RTE product). Before recommending statements on food safety, consumer research should be conducted to evaluate what statements should be used and where they should be placed on the package to adequately convey to the consumer the appropriate message with respect to cooking poultry for microbial safety.

Because all cooking instructions must result in a microbiologically safe product, preparation and cooking instructions provided on the label must be clear and validated to ensure that the consumer will know that the product must

achieve the minimum endpoint temperature of 165°F to ensure food safety. To avoid consumer confusion, the term ''cooking'' in the preparation instruction should be used for product containing NRTE poultry components. The term ''heating'' should be used only for RTE products that are warmed for palatability but that do not require lethality to achieve food safety. If a ''preferred method'' of cooking is identified, the consumer should be informed what is meant by ''preferred method'' (e.g., quality versus safety). In addition, a statement is needed about the internal temperature to which the poultry portion should be cooked (e.g., ''for food safety'' or ''to reduce the risk of foodborne illness'' followed by ''cook to a minimum internal temperature of 165°F''). For example, for partially cooked meat patties, the FSIS requires such a statement on the principal display panel. If the product can be microwaved, the proper use of a thermometer with measurements taken at multiple points should also be indicated because of the variability among microwave ovens.

The Committee recommends that, at least for products that have a cooked appearance but are NRTE, the FSIS should pursue mandating that such products have appropriate and validated cooking instructions on their labels.

IV. RECOMMENDATIONS FOR DATA AND RESEARCH NEEDS

The Committee recognizes that there are inadequate attribution data with regard to foodborne illness. The Committee recommends that the FSIS and the Centers for Disease Control and Prevention (CDC) partner to ensure that programs help address gaps in foodborne illness attribution data, such as through FoodNet *(17),* eFORS (Electronic Foodborne Outbreak Reporting System) *(15),* and future initiatives. Specifically, the FSIS and CDC should encourage local and state health departments to improve their collection of foodborne illness data related to commercial products that for microbiological safety require cooking by the consumer before consumption. The Committee is particularly interested in poultry products that appear to be RTE but actually are NRTE and require cooking (e.g., breaded NRTE poultry). Specifically, when a foodborne illness is attributed to a product, the following data should be collected.

1. Was the product cooked from a frozen state?
2. What cooking method was used to prepare the product? In particular, was the product microwaved?
3. Was the product stuffed?
4. Where was product prepared (at home, food service, etc.)?
5. What were the cooking instructions on the label? (An attempt should be made to obtain the product label.)
6. Did the product label identify the poultry as NRTE? If so, how?
7. Did the product label state that the product should be thoroughly cooked for safety? If so, how?

In order for the FSIS to address the cost and benefit of risk management policies for the safe cooking of poultry, it should partner with the states and food processors to determine food processor practices related to cooking and labeling.

1. What proportion of NRTE poultry products appear to be RTE but require cooking, as compared with NRTE poultry products that do not appear RTE? How has the proportion changed with time?
2. How are commercially prepared poultry products that appear to be RTE but require cooking labeled? What labeling features beyond safe handling instructions indicate that these products require cooking for safety? What proportion of these products is labeled to indicate that they can be microwaved?
3. How are cooking instructions for NRTE poultry products determined? What information is collected by food processors to assess how consumers will interpret and carry out the cooking instructions?
4. What types of studies do the food processors conduct to validate cooking instructions?
5. Are guidelines for studies to validate cooking instructions available or do they need to be developed?

The Committee recommends that the FSIS review agency documents provided to consumers to ensure consistency with the recommended single minimum internal product cooking temperature of 165°F. In addition, the FSIS should work with the Conference for Food Protection to ensure that the Food Code requirements for cooking poultry (165°F for 15 s) are consistent with the Committee recommendation to consumers (165°F with no hold time). The FSIS should ensure that the information above is collected to the extent possible through the USDA Meat and Poultry Hotline database and the FSIS Labeling and Consumer Protection Staff.

V. SUMMARY

The food processor is responsible for providing validated cooking instructions to the consumer that will result in a microbiologically safe product, and the FSIS is responsible for verifying that food processors do so. The food processor must label the product package with clear and concise cooking instructions to the consumer and must validate these cooking instructions. The public health regulatory agencies (e.g., the FSIS and the U.S. Food and Drug Administration) must provide the consumer with guidelines on proper cooking and temperature measurement procedures.

The principal display panel of the package should be the primary focus for certain safety information and should clearly indicate whether the product is RTE or NRTE. It should not be left to the consumer to determine if the product is RTE, especially if the product is partially cooked or otherwise appears to be RTE. When a product contains uncooked poultry, it is necessary to explicitly state this fact and that the product must be thoroughly cooked in accordance with the validated cooking instructions.

When validating the cooking instructions, the food processor must take into account how consumers are likely to interpret cooking instructions and to handle the product. The limitations for the various processing procedures (e.g.,

difficulty in temperature measurement, uneven heating, partially cooked product that appears RTE) should be considered by the food processor when developing and validating cooking instructions.

A single endpoint temperature rather than a time-temperature combination should be recommended to the consumer. The cooking process for poultry should be designed to eliminate *Salmonella.* The Committee recommends that consumers cook poultry to a minimum internal temperature of 165°F for food safety.

Guidelines for the consumer for achieving microbiologically safe poultry products through cooking should be developed. These guidelines should discuss the product condition or state before cooking and provide information on thawing procedures for frozen products that ensure microbiological safety. The consumer should be informed that longer cooking time is needed if the product is to be cooked from the frozen state and that microwaving an NRTE product from the frozen state is not an acceptable cooking method unless the temperature is measured in a sufficient number of locations in the product to ensure the product is properly cooked. The guidelines should also include the proper procedure for measuring product temperature and should describe the procedure, purpose, and importance of calibrating thermometers.

In addition to cooking information, the guidelines should include the need for sanitary handling to prevent cross-contamination of RTE products. Guidelines for safe storage and refrigeration of perishable products should also be included.

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APPENDIX I. REPORT ON SALMONELLOSIS LINKED TO CONSUMING PROCESSED CHICKEN PRODUCTS IN MINNESOTA AND MICHIGAN: SUMMARY OF A PRESENTATION GIVEN TO NACMCF ON 7 JULY 2005 BY MR. KEVIN ELFERING OF THE MINNESOTA DEPARTMENT OF AGRICULTURE

In 2005, the Minnesota and Michigan Departments of Health noted several cases of foodborne illness attributable to *Salmonella* Heidelberg. These cases were linked epidemiologically to the consumption of various commercially processed stuffed-chicken entrees. *Salmonella* isolates from human clinical and chicken product samples were indistinguishable by pulsed-field gel electrophoresis patterns. The entrees in question were uncooked boneless, breaded chicken breast. The breading was browned and gave the product a cooked appearance. Although the labeling had safe handling instructions on the packaging, it was not otherwise designated that the product was not RTE. In addition, the principal display panel indicated that the product was microwaveable. The product had a cooked appearance that was visible through the transparent area of the package.

Because the same product was prepared incorrectly by several households consuming the product, these illnesses were indicative of problems with product handling and preparation instructions. A survey of consumers of the products involved in the Michigan and Minnesota illnesses and the food processor's response demonstrate this point clearly. The majority of consumers thought the product was cooked. They claimed to have followed

TABLE 2. *Lethality of poultry processes*

Process temp (°F)	Process time	Log reduction	
		Salmonella	*Campylobacter*
140	28.2 min	7	85
160	15 s	7	50

the cooking instructions on the package but did not recall a safe handling statement on the package. The consumers stated that they did not see anything on the package indicating that the product was NRTE. Although a final internal temperature of 165°F was recommended on the cooking instructions, no one reported checking the product temperature before consumption. Finally, the consumers did not know the wattage of their microwave ovens. Cooking instructions on the packaging of microwaved RTE products usually tell the consumer to microwave the product on the ''high'' power setting. This assumes that all microwave ovens deliver the same power at the same setting; however, microwave ovens vary in the amount of power used. Consequently, a product may not receive the amount of energy intended or needed for safety.

The processor of the products involved redesigned the packaging to clearly inform the consumer that the product was NRTE and needed to be cooked thoroughly. A symbol with ''Cook Thoroughly'' was added to the front panel and the word ''microwaveable'' was removed. Cooking instructions for a microwave oven also were removed.

APPENDIX II. COMPARISON OF A 7-LOG REDUCTION OF *SALMONELLA* WITH THE LOG REDUCTION OF *CAMPYLOBACTER*

An analysis was conducted by the Committee to determine the lethality of poultry processes on *Campylobacter* in comparison to *Salmonella.* It is estimated that a 7-log reduction process for *Salmonella* would achieve a greater than 50-log reduction for *Campylobacter.*

Basis for the determination. Assume that the 7-log reduction process for *Salmonella* in poultry is 140°F for 28.2 min or 160°F for 15 s (based on a study by Juneja et al. *(4)*; poultry with 6% fat). Based on a study by Blankenship and Craven *(1),* the *D*-value for *Campylobacter* (composite of five strains) in chicken is (by extrapolation using a linear regression of the data in the study) 0.33 min at 140°F and 0.005 min at 160°F. Thus, log reductions can be calculated as illustrated in Table 2.