July 2007

Exploratory Research on Estimation of Consumer-Level Food Loss Conversion Factors

Agreement No. 58-4000-6-0121

Final Report

Prepared for

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1 Introduction

This exploratory study focuses on consumer-level food loss (excluding the inedible portion of food), which is one of four food loss factors in the ERS Loss Adjusted Food Availability Data System.

The Economic Research Service's (ERS's) Loss Adjusted Food Availability Data System provides per capita annual estimates of food consumption calories and weights for over 200 food categories. These data are an often used proxy for actual consumption in studies related to measuring and analyzing changes in food consumption behavior over time. In addition, they are useful for analyzing changes due to major nutrition education and policy initiatives. ERS derives food consumption estimates from per capita food availability data for 217 food categories broadly classified as

- meat, fish, and poultry (including nuts);
- dairy products;
- fruits and vegetables;
- grain products;
- added fats; and
- added sugars.

When deriving food consumption estimates, ERS adjusts food availability data by the following four sets of food loss factors:

- primary to retail weight loss
- retail/institutional to consumer-level loss
- consumer-level inedible share
- other consumer-level loss (cooking loss and uneaten food)

The other consumer-level loss category occurs because of cooking losses, plate loss (also referred to as plate waste), spoilage, and other types of losses other than the inedible portion of the food. The degree of these losses might depend

on whether the food is perishable; the typical shelf-life of perishable foods; whether the food is usually an ingredient in cooking or eaten without further preparation; and whether the food is typically consumed by children, adults, or seniors. Consumer-level losses also differ depending on whether the food is prepared at home or away from home. Because food consumed away from home accounts for nearly half of total food purchase dollars, it is important to understand how food loss for food consumed away from home differs from food loss at home. In particular, types of food, cooking methods, and spoilage or discarding of unused food likely differ substantially.

1.1 PURPOSE OF THE EXPLORATORY RESEARCH STUDY

The purpose of this study was to conduct exploratory research on consumer-level food loss to help inform the development of a complete study to develop estimates of food loss for individual food categories.

The purpose of this study was to conduct exploratory research on consumer-level food loss to help inform the development of a complete study to develop estimates of food loss for individual food categories. The exploratory research included reviewing published literature on consumer-level food loss, conducting interviews with foodservice establishments since less information is known about away-from-home food loss than at-home food loss, and investigating a method for comparing purchase data to consumption data to estimate consumer-level food loss conversion factors.

1.2 OVERVIEW OF THE REPORT

This report is organized as follows. Section 2 provides a review of the limited previous research on consumer-level food loss. Section 3 discusses the process for and results of interviews with restaurant and foodservice operation managers regarding food losses in their establishments. Section 4 describes a numerical approach for estimating consumer-level food loss, provides examples for the numerical approach, and discusses issues that must be resolved to implement the numerical approach. Finally, Section 5 provides recommendations for developing the complete set of estimates of consumer-level food loss for all food categories.

2 Published Literature on Consumer-Level Food Loss

The published literature on consumer-level food loss provides information on

- causes of food loss,
- methods of estimating food loss, and
- ranges of estimates of food loss.

Most studies of consumer-level food loss are somewhat dated or focus on particular consumption settings (e.g., homes, schools, institutions) and particular populations or geographic locations. Although most studies address differences across types of food, the food categories are very broad. However, even given the limitations, the published literature provides general estimates of food loss in homes and foodservice settings. In the discussion below, we summarize information from the published literature on causes of consumer-level food loss (particularly in institutional settings), methods of estimating food loss, and ranges of estimates for food loss. The discussion focuses on more recent literature and also notes comparisons to previous studies indicated by the authors of the publications.

2.1 CAUSES OF CONSUMER-LEVEL FOOD LOSS

Food loss refers to food that was once usable for human consumption but is discarded without being eaten (Gallo, 1980). In the home, uneaten food is discarded in trash bins, poured down drains and garbage disposals, and fed to animals and birds (Gallo, 1980). Some of the causes of home food loss include spoilage of food before or after preparation, breakage and spillage of containers, losses to rodents or insects, preparation of too much food (leftovers not consumed), cooking or preparation losses such as discarded cooking oils or discarded inedible portions, and plate loss after food is served (Gallo, 1980; Kantor et al., 1997; Engstrom and Carlsson-Kanyama, 2004). In foodservice settings, uneaten food is discarded in similar ways but is less likely to be fed to animals

and birds and might be reused by food pantries. Some of the causes of foodservice food loss include overpreparation of menu items that are prepared for uncertain orders, expanded menus that make management of food inventories more difficult, unexpected fluctuations in food sales, and plate loss (especially due to increasing portion sizes) (Kantor et al., 1997). In school cafeterias, some of the causes of food loss include lack of knowledge of preferences and acceptance of menu items and temperature and quality of food (Marlette, Templeton, and Panemangalore, 2005).

2.2 METHODS OF ESTIMATING CONSUMER-LEVEL FOOD LOSS

The methods of estimating consumer-level food losses include the following:

- dietary recall—individuals keep diaries or are interviewed on their food discards
- archeological—trained observers examine garbage and then estimate or measure food discards
- plate examination—researchers examine and then estimate or measure plate loss
- inferential—calculations are made based on secondary data on food purchased compared with food consumed (Gallo, 1980; Buzby and Guthrie, 2002; Adams et al., 2005)

Each method may capture some level of information but each has drawbacks. For example, dietary recall methods are very reactive in that participants in a study will modify their food use behavior because they are being observed (Gallo, 1980) or are subject to bias in estimation (Buzby and Guthrie, 2002; Adams et al., 2005). Archeological methods cannot be used to capture wasted liquids, food discarded in garbage disposals, or discarded food fed to pets and birds. Plate examination captures only plate loss and not other types of consumer-level food losses (Gallo, 1980). In addition, this method is costly, time consuming, and impractical for large samples (Buzby and Guthrie, 2002). Finally, the availability and accuracy of data sets available for inferential estimation affect the ability to use this method. Across all methods, extrapolating the results to many different categories of foods may be difficult.

2.3 ESTIMATES OF CONSUMER-LEVEL FOOD LOSS

Previous estimates of consumer-level food loss by ERS indicate that approximately 26% of edible food supplies are typically lost by consumers and foodservice operations (Kantor et al., 1997; Kantor, 1998). This estimate was developed based on limited published studies and discussions with commodity experts. Fresh fruits and vegetables, fluid milk, grain products, and sweeteners (mostly sugar and high fructose corn syrup) accounted for two-thirds of consumer-level food loss (Kantor, 1998). The highest percentage of food losses, 50%, was associated with fats and oils used by foodservice establishments, including shortening, lard, and tallow.

Earlier research, as described in Gallo (1980), found that 7% to 35% of food purchased by consumers was lost, but this range of estimates included losses associated with inedible portions. In general, an estimate of 7% is more typical of dietary recall and archeological methods of estimating food losses. However, it may understate losses because fat, discarded liquids, discards in garbage disposals, and food fed to animals and birds were likely not fully accounted for in the estimate. The 35% estimate was derived using an inferential method and may be a more accurate estimate because it accounts for all types of waste and is a nonreactive method of estimating losses. The specific estimate was obtained as the difference between the daily average per-person number of calories brought into the home (2,900) and the number of calories consumed (1,900). Plate examination methods have generally resulted in estimates between the two extremes. The source of the data used for the estimation was the Nationwide Food Consumption Survey, which included estimates of total quantities of food brought into the home and consumed based on a diary and interview recall method.

A comprehensive study of food losses in homes in Oregon was conducted through personal interviews, 7-day diary recordings by 243 households, and 3-day measurements of discards in 50 households (van Guarde and Woodburn, 1987). Major reasons for discarding food included poor quality of fruits and vegetables; spoilage in storage for meat, fish, and poultry; nonuse of leftovers for combination dishes; and plate loss for cereal and dairy products. The results indicated that 6% of the

weight of food averaged across all categories was discarded. This estimate is similar to cited estimates of 3% to 9% from several earlier studies. The losses in descending order of total weight lost were as follows:

- fruits and vegetables;
- cereals;
- combination dishes; and
- meat, fish, and poultry.

The authors did not provide estimates of the percentage of losses relative to purchases for these categories.

A recent study of food losses in foodservice settings in Sweden found that approximately 20% of food is lost, and more than half of the loss occurs because of plate loss (Engstrom and Carlsson-Kanyama, 2004). The study was based on visual examination and recording of estimated percentages of waste and semistructured interviews in two restaurants and two schools. The study found that losses are typically higher, in the 24% to 35% range, for food served in school cafeterias. However, the study excluded waste resulting from beverage consumption. Preparation losses, which included removal of inedible portions, was estimated to be 3% to 8% of the food delivered. Storage losses were minimal (maximum of 1%). Leftovers accounted for a maximum of 6% of losses. Plate loss accounted for 9% to 11%, with losses being higher for potatoes, rice, and pasta. The plate loss was extremely low for meat and fish.

Similar to the Engstrom and Carlsson-Kanyama (2004) study, a study of calorie losses from food served to students under the National School Lunch program in the United States estimated that 12% of calories served are lost because of plate loss (Buzby and Guthrie, 2002). The foods with the highest amount of waste were salad, vegetables, fruits, and bread. The authors noted that estimates of plate loss in smaller studies ranged from 10% to 37% because of local variation in plate loss and differences in methods used. The study with the highest estimated food losses found that more than half of salad, vegetables, potatoes, and bread were discarded as plate loss (Reger et al., 1996).

A recent study of plate loss in schools was conducted by photographing lunches after students selected their food and

after they ate it (Marlette, Templeton, and Panemangalore, 2005). Plate loss varied depending on whether students purchased competitive food items such as salty or sweet snacks or whether they did not purchase such items. For students who did not purchase competitive food items, plate loss averaged 36% for fruits, 14% for grain products, 16% for meats, and 18% for mixed dishes. Losses increased substantially for students who purchased competitive food items.

2.4 FACTORS AFFECTING CONSUMER-LEVEL FOOD LOSS

Across the published literature, the types of factors that increase the amount of food loss include the following:

- seasonality—more waste occurs in summer months (Gallo, 1980)
- age of children—younger children waste more than older children in school cafeterias and at home (Gallo, 1980; Buzby and Guthrie, 2002)
- gender—females waste more than males (Gallo, 1980; Buzby and Guthrie, 2002)
- income—higher-income individuals waste more than lower-income individuals (Engstrom and Carlsson-Kanyama, 2004; Buzby and Guthrie, 2002; van Guarde and Woodburn, 1987)
- setting—more waste is associated with hospitals and military mess halls than with school and company cafeterias (Engstrom and Carlsson-Kanyama, 2004)
- size of household—larger households waste more than smaller households because of a greater number of children in the household (van Guarde and Woodburn, 1987)

The implication of these findings when estimating food loss for individual food categories is that some thought should be given to which types of individuals typically consume the food and in which types of settings the food is consumed. However, based on the published literature, only general inferences can be drawn based on these factors.

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3 Results of Restaurant Interviews

We conducted interviews with kitchen managers to obtain a better understanding of food loss that occurs in restaurants and other foodservice settings.

Food consumed away from home accounts for nearly half of total food purchase expenditures. Less information is known about away-from-home food loss compared with at-home food loss. To inform the development of food loss conversion factors that account for away-from-home food consumption, we conducted interviews with 14 kitchen managers to understand food loss at restaurants. In this section, we describe the procedures and materials used to conduct the interviews, summarize our findings, and indicate the implications of the findings.

3.1 PROCESS USED FOR CONDUCTING INTERVIEWS WITH RESTAURANT MANAGERS

We describe below the procedures and materials used to conduct the interviews with restaurant managers. We recruited participants and conducted the interviews in the winter and spring of 2007.

3.1.1 Development of Interview Materials

RTI developed a project description sheet and a discussion guide for conducting the interviews (see Appendix A). The project description sheet introduced potential participants to the project and helped individuals we initially contacted determine, if necessary, the appropriate respondents from their establishments. The description explained the purpose of the project, listed the general topics of interest, explained how RTI would use the information obtained, reiterated that all responses would be kept confidential, and provided full contact

information for an RTI project member and the ERS technical lead.

The discussion guide was used to conduct interviews and record responses during the interviews. It included questions on the types of food loss that occur at their restaurants (e.g., cooking losses, plate waste, spoilage, other types of food loss) and the amount of loss of certain food types (e.g., meat, bread, dairy). The discussion guide was general to allow for open-ended responses from those we interviewed.

3.1.2 Recruitment of Study Participants

RTI used a variety of recruiting methods to recruit kitchen managers of restaurants to participate in the study, including

- calls to individuals at the headquarters of chain restaurants from an online database, the Chain Restaurant Operators Database,[1] which includes restaurant chains in quick service, family dining, and fine dining;
- calls to individuals at the local level of chain restaurants in quick service, family dining, and fine dining from a list obtained through Dun & Bradstreet;
- calls to restaurants in Wake County, North Carolina, from a list of restaurants provided by the North Carolina Restaurant and Lodging Association;
- calls or in-person visits to personal contacts who manage cafeterias;
- in-person visits to a variety of local restaurants in Wake and Durham counties, North Carolina; and
- in-person contacts at the National Restaurant Association Restaurant Hotel-Motel Show in Chicago, Illinois on May 20–21, 2007.

Recruiting restaurant managers to participate in interviews was difficult because they tend to have extremely busy work schedules, and they saw little benefit to themselves for participating in the study.[2] Also, staff members at the corporate level of chain restaurant were not willing to allow their staff to participate in interviews. This reluctance was either because

[1]Information on the Chain Restaurant Operators Database is available at http://www.csgis.com/csgis-frontend/catalog.do?code=RSTG_RESTAURANT.

[2]In the future, we would recommend use of a cash incentive to increase the willingness of restaurant managers to participate in interviews.

these staff members did not want to burden their employees or because they were concerned about revealing competitive information. Some restaurant managers may consider food loss to be a sensitive topic because it affects profits, and there is some amount of cultural aversion to wasting food. We had substantially more success recruiting participants through in-person visits than by telephone because it was easier to build trust and a personal interest in the study.

Once potential participants were identified, RTI provided the project description sheet. After participants reviewed the information and agreed to participate, RTI scheduled a teleconference call or an in-person meeting.[3] At the beginning of each interview, RTI reviewed the project description with each respondent and reiterated that all responses would be aggregated and that no identifying information would be provided in the report. We used the discussion guide to facilitate the discussions and record notes. The length of each discussion ranged from 30 minutes to 1 hour.

3.1.3 Analysis

The interviewers took extensive notes during each discussion, and an RTI team member summarized the responses immediately after each interview. The detailed summaries of each interview were systematically analyzed to identify common themes and any exceptions to these themes.

3.2 SUMMARY OF RESULTS OF INTERVIEWS WITH RESTAURANT MANAGERS

This section summarizes the findings of the interviews RTI conducted with kitchen managers to learn about food loss among selected food categories at the restaurant level. In interpreting the results of the interviews, it is important to keep in mind that restaurants seek to minimize food loss through careful timing of food deliveries, monitoring inventories, establishing loss standards, and training employees. Because restaurants are in business to earn profits, it seemed that some

[3]In-person interviews tended to yield more in-depth information compared with telephone interviews and, in some cases, allowed us to see actual kitchen operations. However, conducting interviews by telephone allowed us to interview restaurants outside of the local area and to conduct interviews that best suited some of the interviewees' schedules.

interviewees sought to downplay the amount of food loss they experience.[4]

Overall, we completed 14 interviews with kitchen managers from two quick service restaurants, seven family dining restaurants, two fine dining restaurants, and three cafeterias. The kitchen managers worked for six national chain restaurants, one regional chain restaurant, four independently operated restaurants, one hospital cafeteria, one assisted-living cafeteria, and one work-site cafeteria. Six restaurants were in Raleigh, North Carolina, two restaurants were in Philadelphia, Pennsylvania; and one restaurant each in Atlanta, Georgia; Minneapolis, Minnesota; and Detroit, Michigan. The kitchen managers of the hospital cafeteria and the assisted-living cafeteria are located in Canton, Ohio, and the kitchen manager of a work-site cafeteria is located in Durham, North Carolina.

3.2.1 Meat, Poultry, and Fish

The findings of the interviews for the meat, poultry, and fish product categories indicate restaurants and foodservice establishments receive frequent deliveries of these products and that little is lost through cooking losses, none is lost through spoilage, and some is lost through plate loss. A summary of the findings is as follows:

- Many establishments receive meat, poultry, and fish twice per week, and a few establishments receive meat, poultry, and fish everyday, except Sundays. A few establishments receive meat and poultry at most twice per week and fish at least three times per week. One establishment receives meat, poultry, and fish once per week.
- Most establishments do not lose meat, poultry, or fish during food preparation. The majority of kitchen managers receive meat, poultry, and fish that are pre-cut, so there is no preparation work or waste. Of the few kitchen managers who receive meat, poultry, and fish whole, many kitchen managers use the trimmings to make stocks, but a few kitchen managers estimate they lose 5% to 10% of chicken, and depending on the fat content, 3% to 5% of red meat during food preparation.

[4]Some restaurants also reduce food loss by donating leftovers of unserved food to homeless shelters and other community service organizations for altruistic reasons. One kitchen manager we interviewed said that 5% of prepared food is donated daily.

- No kitchen managers said they lose meat, poultry, or fish during storage (because of spoilage or other reasons).
- A few establishments throw away approximately 2% to 5% of red meat that has been overcooked according to the customer. However, one kitchen manager in North Carolina mentioned that hamburgers are rarely considered overcooked because state law requires all burgers to be cooked to at least medium-well.
- If establishments have any leftover cooked meat, poultry, or fish at the end of the night, a few establishments will refrigerate or freeze the leftovers and use them in lunch or special menu items. Most establishments' leftover meat, poultry, or fish totals a small percentage (e.g., less than 1%) and is thrown away at the end of each night.
- Plate loss for meat, poultry, and fish uneaten by customers is relatively rare. Customers tend to eat all the meat, poultry, or fish they are served or to take home leftovers in a take-home bag. However, at least two kitchen managers believe their portion sizes are too large and estimate customers do not eat 10% to 15% of the meat, poultry, and fish served. The two kitchen managers who work for the hospital and assisted-living cafeterias estimate customers do not eat 25% and 40% of the meat, poultry, and fish served.

3.2.2 Dairy Products

The findings of the interviews for the dairy product category indicate restaurants and foodservice establishments receive relatively frequent deliveries of these products (but less frequently than meat, poultry, and fish) and that little is lost through cooking losses, a small amount is lost through spoilage, and a small amount is lost through plate loss. A summary of the findings is as follows:

- Many establishments receive dairy products twice per week, while a few establishments receive dairy products at least three times per week. A few establishments receive dairy products once per week.
- Many establishments experience no loss of dairy products during food preparation. The few kitchen managers who remove sour cream and/or shredded cheese from its original container to place it in another container lose about 1 or 2 ounces in the original container. The few establishments that slice or shred their own cheeses lose no more than 1% of cheese,

which either falls on the floor or remains on the slicer. One establishment that makes its own desserts in-house loses 80% of egg whites because most pastry recipes use more egg yolks. Another kitchen manager said the establishment loses about 1% of liquid margarine, which is mostly used to grease the grill and cooking pans, to overuse.

- Most establishments experience no loss of dairy products during cold storage. A few establishments lose, at most, 1% of milk and cheese in cold storage. One kitchen manager said the establishment loses about 3% of prepackaged, individual-sized yogurts and milk containers during cold storage.
- Most kitchen managers believe any unused amount of butter, margarine, creamers, or any other dairy product placed on customer tables is immeasurable because it is a small percentage and generally not observed by staff.

3.2.3 Fruits and Vegetables

The findings of the interviews for the fruit and vegetable product categories indicate restaurants and foodservice establishments receive very frequent deliveries of these products (similar to meat, poultry, and fish) and a small amount is lost through cooking and preparation losses, storage losses (spoilage), and plate loss. A summary of the findings is as follows:

- Some establishments receive fruits and vegetables twice per week. A few establishments receive fruits and vegetables everyday, except Sundays. A few establishments receive fruits and vegetables three or four times per week, and one establishment receives fruits and vegetables once per week.
- Most establishments interviewed do not use a lot of fresh fruit. Most fruits, such as lemons, limes, and oranges, are used to make cocktails. Most restaurant bars discard less than 5% of unused, prepped fruit and lose less than 2% of fruit and fruit juices in cold storage. However, the kitchen manager of the hospital cafeteria estimates anywhere from 0% to 25% of fruit that is on display, depending on season, is discarded due to appearance rather than spoilage. The kitchen manager of the assisted-living facility mentioned that residents usually take fruits with them if the fruits are not eaten at scheduled meals.
- Most establishments lose some vegetables during food preparation. However, a few establishments use the

trimmings of some vegetables (e.g., celery stalks, carrots, parsley) as plate garnishes, to make stocks, or in other menu items. During food preparation, most establishments lose between 2% and 12% of usable vegetables. One establishment loses about 25% of cilantro because it does not use the stems.

- Many establishments lose some vegetables during cold storage, but a few kitchen managers said their establishments do not lose any vegetables with the exception of lettuce. Most establishments lose 3% to 7% of most vegetables, 5% to 10% of lettuce, and 5% to 20% of cucumbers because of storage losses. A few of these establishments lose between 3% and 15% of fresh herbs.
- Some establishments discard 1% to 5% of prepped or cooked vegetables. Of the establishments with salad bars, most discard 1% to 3% of the bar's vegetable contents. A few kitchen managers discard about 10% of prepped lettuce.
- Most kitchen managers estimate less than 2% of vegetables are lost due to plate loss. However, the kitchen manager of the assisted-living cafeteria estimates that residents discard 60% of their vegetables, and a kitchen manager of a restaurant that serves very large portions estimates that his customers discard 25% of the lettuce served to them.

3.2.4 Grain and Bread Products

The findings of the interviews for the grain and bread product categories indicate restaurants and foodservice establishments receive frequent deliveries of grain and bread products (similar to meat, poultry, and fish), and a small amount is lost through cooking and preparation losses, a small amount is lost through storage (e.g., from drying out), and a moderate amount is lost because of plate loss. A summary of the findings is as follows:

- Some establishments make their own bread and/or pizza dough in-house everyday; of these establishments, a few receive deliveries of grain and bread products once or twice per week, while others receive them three or four times per week. Some establishments receive grain and bread products once or twice per week, and a few establishments receive grain and bread products three or four times per week.
- Most establishments do not lose grain or bread products during food preparation. Most establishments that make their own bread in-house use the ends of bread to make

croutons. One kitchen manager estimates the establishment discards 1% or 2% of unused croutons. A few kitchen managers of establishments that make pizza estimate they lose at most 2% of pizza dough to human error (i.e., neglect during preparation). One kitchen manager of an establishment that makes its own desserts in-house mentioned that the establishment discards scraps of dough when making pastries (e.g., cut-out cookies, tarts).

- Most establishments do not lose grain or bread products during storage. However, a few kitchen managers estimate they lose about 2% to 10% of their bread in storage. A few kitchen managers estimate they lose 4% to 5% of bread because of quality issues; for example, pita bread that is too dry to open or tortilla wraps that are torn.
- Some kitchen managers consider breads and grain products to have the highest food product loss. Some kitchen managers estimate the establishment discards 10% to 20% of cooked rice and pasta, while others estimate the establishment only loses what sticks to the pot. One kitchen manager estimates the establishment discards 6% of unused pizzas. One kitchen manager who prepares breakfast estimates the establishment throws away approximately a half-gallon of pancake batter and approximately 3 gallons of cream of wheat and grits, but no oatmeal, on a daily basis.
- Many of the establishments serve bread to each table, and most of the kitchen managers for these establishments believe less than 1% of the bread served at the table is leftover and discarded. One kitchen manager, however, estimates 30% to 40% of the bread put on the table during the evening and 50% of the bread put out during lunch is discarded. A few kitchen managers mentioned that customers who order sandwiches leave a portion of their sandwich buns uneaten, especially during lunch. At least two kitchen managers estimate 15% to 25% of pasta is left on customers' plates. However, some customers take home leftover pasta in a take-home bag to eat later. One kitchen manager estimates that customers throw away 30% of tortillas chips served. Finally, one kitchen manager estimates that customers leave at most 2% of pizza uneaten.

3.2.5 Fats and Cooking Oils

The findings of the interviews for the fat and cooking oils product categories indicate restaurants and foodservice

establishments receive less frequent deliveries of fats and cooking oils than other products and that a moderate amount is lost through cooking losses, none is lost through storage, and little of the oil used in salad dressing is lost because of plate loss. A summary of the findings is as follows:

- Establishments use a variety of cooking oils, including olive, vegetable, soy, and canola, and many establishments use a butter substitute. The majority of establishments receive fats and oils twice per week, while a few establishments receive fats and oils at most once per week.
- The majority of kitchen managers acknowledge that fats and oils are lost on the grill, in pans, and in fryers and because of occasional human error, but they cannot estimate how much is lost. One kitchen manager estimates the establishment loses 20% of the butter substitute used to season the grill when the grill is scraped. One kitchen manager estimates about 50% of cooking sprays do not adhere to the pot or pan. Finally, one kitchen manager estimates 3% to 4% of cooking oil is wasted because of spills or measuring errors when preparing foods.
- Most kitchen managers say few customers order salad dressings on the side, and those who do usually use nearly all the dressing. Thus, plate loss for salad dressings is minimal.

3.2.6 Sugars and Sweeteners

The findings of the interviews for the sugars and sweeteners product categories indicate restaurants and foodservice establishments receive relatively infrequent deliveries of these products and that none are lost through cooking losses, none are lost through storage, and a small amount is lost due to discarded sweetened iced tea. A summary of the findings is as follows:

- The majority of establishments receive sugars and sweeteners no more than twice per week. A few establishments receive sugars and sweeteners on an as-needed basis. Some establishments receive individual packets of sugar, while others receive 5- to 25-pound bags.
- The majority of kitchen managers experience no loss of sugars and sweeteners. Of the establishments that make sweet tea, many discard about 1 or 2 gallons of sweet

tea daily, which contains about one-half or one cup of sugar.

3.3 IMPLICATIONS OF RESULTS ON RELATIVE AMOUNTS OF LOSS AT HOME AND AWAY FROM HOME

An understanding of the relative losses helps contribute to developing a method to estimate food loss across different categories of food in a manner that accounts for both types of food consumption settings.

In this section, we present some implications from the findings of the restaurant interviews regarding the relative amounts of loss that occur at restaurants and foodservice establishments (away from home) compared with food loss that occurs in households (at home). An understanding of the relative losses helps contribute to developing a method to estimate food loss across different categories of food in a manner that accounts for both types of food consumption settings. Our preliminary implications are as follows:

- **Food loss through plate loss is likely greater in restaurants than in households.** Some of the kitchen managers believe most of their customers generally finish their meals because they paid for it. However, a few kitchen managers admitted that their establishments' portion sizes were too big, and they estimate customers leave 5% to 10% of their total meals uneaten. For many kitchen managers, it was difficult for them to estimate the amount of food left on customers' plates. Also, many customers take home leftover food to consume later, but the quantity of food taken home is also difficult for kitchen managers to estimate. Food left on the plate is usually side items (e.g., potatoes, rice, pasta, vegetables) rather than meat, poultry, or fish. Food losses through plate loss in institutional settings are substantially larger with an estimated 80% to 85% of individuals discarding some amount of food served.
- **Cooking loss for meat, poultry, and fish may be greater for households than for restaurants.** Households likely purchase more meat, poultry, and fish products for at-home use that need trimming than do restaurants that purchase precut products, and consumers are less likely to reuse these trimmings in stocks and other foods.
- **Cooking loss for fats and cooking oils is likely greater for restaurants than for households.** More foods tend to be fried in restaurants, particularly in deep fat fryers, than foods prepared at home. Frying oil must be discarded and replaced on a periodic basis (typically weekly).

- **Spoilage loss of dairy products, fresh fruits, and fresh vegetables is likely greater for at-home consumption than for restaurants.** In restaurants, dairy products, fresh fruits, and fresh vegetables are ordered on a frequent basis and stored for only short periods of time. In contrast, households purchase these products less frequently, store them longer, and are less likely to monitor at-home inventories. Foods with open dates (e.g., use by or sell by dates) are more likely to be discarded because of expired dates in households than in restaurants. Furthermore, use of fresh fruits in restaurants appears to be less frequent than in households; therefore, the volume possibly subject to loss is less.

4 Example of a Numerical Estimation Method for Consumer-Level Food Loss

Existing data sources can be used to estimate consumer-level food loss, but additional assumptions are needed to apply the estimation method.

In this section, we describe a method that could be applied to estimate consumer-level food losses using existing data sources. The method is based on comparing estimates of food purchase quantities against estimates of food consumption quantities and attributing differences in the two estimates to consumer-level food loss. We provide examples of how the method could be applied and describe additional assumptions that are needed to apply the method.

4.1 DATA SOURCES AND MANIPULATION

To explore a possible numerical method for estimating consumer-level food loss, we focused on the following example food categories:

- yogurt
- peanut butter
- cane and beet sugar
- shortening
- fresh apples
- fresh and frozen fish and shellfish

We selected these categories as examples of a range of products including dairy products, staple products, ingredients, fresh fruits and vegetables, and protein foods. Shortening is

similar to grains in that it is always used as an ingredient in other foods.

We obtained the *consumption estimates* for the list of food categories from the first day of the 24-hour dietary recall data for National Health and Nutrition Examination Survey (NHANES), 2003–2004.[5] Table B-1 in Appendix B lists the products in NHANES included in each product category used in our preliminary calculations. Almost 10,000 individuals participated in the 2003–2004 survey. Consumption estimates in the NHANES data set include only the edible portion of the food. We applied the survey weights available in the data set to derive national estimates of daily per capita mean consumption (grams/person). We then multiplied the estimates by 365 to obtain an annual per capita estimate, multiplied the result by the Census estimate of the U.S. population in December 2004 (286,804,115), and multiplied by 0.035273 to convert grams to ounces.

We obtained the *purchase estimates* for the list of food categories from The Nielsen Company's Homescan data for 2004.[6] The data sets for 2004 include all purchases for approximately 40,000 households in the static mega panel and approximately 8,000 households in the static fresh foods panel.[7] Households in the mega panel record purchases for only food products with universal product codes (UPCs), while households in the fresh foods panel record purchases for random weight products (e.g., fresh apples, seafood) in addition to products with UPCs. We applied the projection factors available in the data sets to the quantity of products purchased multiplied by the weight of each product to derive national estimates of total annual purchase quantities (ounces) by all U.S. households. Table 4-1 lists the broad product categories, number of purchase records for all households combined, and total estimated ounces of the purchases for

[5]We downloaded the data from http://www.cdc.gov/nchs/about/major/nhanes/nhanes2003-2004/exam03_04.htm.

[6]Alternatively, the purchase estimates could be based on Nielsen's Scantrack data that are obtained directly from store purchases rather than rescanned household purchases.

[7]The static panel includes households that reported purchases for 10 of 12 months during the year (see Muth, Siegel, and Zhen [2007]).

Table 4-1. Nielsen Homescan Product Categories for Estimating Food Purchase Quantities, 2004

Food Category	Homescan Category	No. of Purchase Records	Total National Ounces
Yogurt	Yogurt—snacks	13,168	658,402,118
	Yogurt—common	535,475	26,096,666,904
	Total yogurt	**548,643**	**26,755,069,023**
Peanut butter	**Total peanut butter**	**131,189**	**10,721,141,089**
Cane and beet sugar	Sugar—brown	38,321	3,341,460,490
	Sugar—powdered	23,091	2,366,616,014
	Sugar—remaining	2,597	129,349,185
	Sugar—granulated	128,114	2,391,680,730
	Total sugar	**192,123**	**8,229,106,419**
Shortening	**Total shortening**	**18,649**	**2,059,237,771**
Apples	Apples—random weight	50,178	4,725,979,837
	Apples—produce	67,194	10,841,025,301
	Total apples	**117,372**	**15,567,005,138**
Fresh and frozen fish and shellfish	Shellfish—random weight	12,185	865,842,536
	Fish—random weight	21,401	1,553,734,977
	Seafood—fish-breaded—frozen	38,406	2,884,184,237
	Entrees—seafood—2 food—frozen	3,583	132,751,630
	Entrees—seafood—1 food—frozen	23,696	952,094,339
	Seafood—shrimp—breaded—frozen	8,991	560,084,122
	Seafood—crab—unbreaded—frozen	2,554	191,829,816
	Seafood—remaining—breaded—frozen	1,116	38,278,862
	Seafood—shrimp—unbreaded—frozen	23,665	1,665,544,333
	Seafood—fish—unbreaded-frozen	20,145	1,674,613,474
	Seafood—remaining—unbreaded—frozen	2,391	127,045,355
	Total fresh and frozen fish and shellfish	**158,133**	**10,646,003,683**

2004.[8] Nielsen Homescan data include only purchases of food for at-home consumption; thus, consumption of food at restaurants and other types of foodservice establishments is not represented in the total estimates.

4.2 EXAMPLES OF CALCULATION METHOD

Table 4-2 provides examples of the calculations for estimating consumer-level food loss by comparing the projected weighted data from NHANES versus data from Nielsen Homescan for each of the six example product categories. Total purchases (TP) are calculated as follows:

$$TP = [NP \bullet (1 - P\_I)]/P\_R \qquad (4.1)$$

where NP is total purchases calculated from Nielsen Homescan data (or, alternatively, Nielsen Scantrack data), P_I is the percentage of inedible product by weight, and P_R is the percentage of product consumed from retail purchases (instead of from foodservice purchases). The percentage of consumer-level food loss (P_CFL) is then calculated as

$$P\_CFL = (TP - NC)/TP \qquad (4.2)$$

where NC is the estimate of consumption from NHANES.

In Equation 4.1, the value for P_I, the inedible percentage of the product weight, is obtained from ERS's existing food availability tables for this example. These estimates are also available from U.S. Department of Agriculture, Agricultural Research Service's online National Nutrient Database for Standard Reference.[9]

The value for P_R, the percentage of the weight of the food consumed from retail purchases, is not available from published sources, and it may need to be estimated based on expert opinion. In the examples provided in Table 4-2, assumed values are used for illustration purposes. For some foods, the percentage of weight is a large percentage of the total weight of the food consumed; thus, the value of P_R can have a

[8]The list of products included in the analysis from the Homescan data totals hundreds of individual UPC products. RTI can provide the detailed list in an Excel spreadsheet if ERS desires.

[9]The National Nutrient Database for Standard Reference is available at http://www.nal.usda.gov/fnic/foodcomp/search/.

Table 4-2. Example Food-Loss Calculations for Six Food Categories (Ounces)

Food Category	Nielsen Grocery Purchases (2004)	% Inedible[a]	Total Consumable Grocery Purchases[b]	Assumed % Consumed from Retail Purchases[c]	Calculated Total Purchases (Retail and Foodservice)[d]	NHANES Food Consumption (2003–2004)	Total Purchases Minus NHANES Consumption	% Consumer-Level Losses
	NP	P_I	—	P_R	TP	NC	CFL	P_CFL
Yogurt	26,755,069,023	0%	26,755,069,023	90%	29,727,854,470	27,047,769,506	2,680,084,963	9.02%
Peanut butter	10,721,141,089	0%	10,721,141,089	95%	11,285,411,673	9,406,493,360	1,878,918,313	16.65%
Cane and beet sugar	8,229,106,419	0%	8,229,106,419	80%	10,286,383,024	9,543,721,523	742,661,501	7.22%
Shortening	2,059,237,771	0%	2,059,237,771	80%	2,574,047,213	Not available[e]		
Fresh apples	15,567,005,138	8%	14,321,644,727	30%	51,890,017,127	50,738,236,479	1,151,780,648	2.22%
Fresh and frozen fish and shellfish	10,646,003,683	0%	10,646,003,683	25%	42,584,014,733	39,867,349,536	2,716,665,197	6.38%

[a] Preliminary values were obtained from ERS food availability worksheets. These values may need to be reviewed to ensure their applicability for these calculations.

[b] Total consumable grocery purchases are calculated by multiplying Nielsen grocery purchases by the percentage of inedible weight.

[c] Assumed values are used in this example. A method of estimating this percentage needs to be developed.

[d] Total purchases are calculated by dividing total consumable grocery purchases by the percentage consumed from retail purchases.

[e] Because shortening is only consumed as an ingredient in food, consumption estimates are not available in NHANES.

substantial effect on the resulting consumer-level food loss estimate.

In Table 4-2, the estimated percentages of food loss for yogurt, 9%; peanut butter, 17%; and sugar, 7% are reasonable considering assumed values for percentage consumed from retail purchases. ERS's current estimates of food loss for these products are 20% for yogurt, 10% for peanut butter, and 20% for sugar. However, the food loss estimate generated using this method may still need further adjustment to account for the proportion of the food purchased at grocery stores that is used in recipes (e.g., yogurt dip, peanut butter cookies, baked goods with sugar as an ingredient). The portion of these foods used as ingredients in recipes would be reflected in the Nielsen Homescan data for the product category, but the foods in which they are consumed would be reflected in many other unknown food categories in the NHANES consumption data. Because it would likely be impractical to calculate the amount of the product used as an ingredient in the various food categories, the difference between the purchase data and the consumption data would be overstating the amount of loss.

In the case of shortening, NHANES does not provide an estimate of consumption because it is only consumed as an ingredient in other foods. Thus, for all products that are used only as ingredients, an alternative method of estimating total consumption would need to be developed. For the list of products in ERS's Loss Adjusted Food Availability Data System, approximately 20 to 25 food categories (particularly in the grain products category) are likely only used as ingredients and thus would not be reflected in NHANES consumption data.

For fresh apples and seafood (fresh and frozen fish and shellfish), more difficulties arise in calculating consumer-level losses. The projected Nielsen Homescan data provide grocery purchase estimates that are substantially lower than the weighted consumption estimates calculated from NHANES data. Both of these categories are calculated from data for the static mega panel and the static fresh foods panel, but the differences between purchases and consumption indicate that Nielsen

Homescan data may be underrepresenting purchases.[10] Part of the difference may be attributable to purchases of fresh foods at other types of establishments such as farmers' markets or seafood shops. However, the differences appear to be too large for this reason to account for the difference. As indicated in Table 4-2, we used assumed percentages for consumed from retail purchases of 30% for apples and 25% for seafood to obtain estimates of food loss of 2% for apples and 6% for seafood. The current estimates from ERS are 20% for the fresh apple product category and 33% for the fresh and frozen fish and the fresh and frozen shellfish product categories.

4.3 ISSUES IN APPLYING METHOD ACROSS ALL FOOD CATEGORIES

The examples provided in Section 4.2 indicate several issues that need to be addressed when applying the method of comparing Nielsen Homescan data to NHANES consumption data to estimate consumer-level food loss. These issues are as follows:

- Estimates of the proportion of the weight of each product category consumed at home versus away from home are needed to adjust Nielsen Homescan or Nielsen Scantrack data to reflect all purchases, including restaurant and foodservice.
- Estimates of the inedible share for each product category will need to be reviewed to determine whether they need adjustment before calculating the estimate of total consumable grocery purchases.
- Foods that are used only or predominately as ingredients will need another method to estimate consumption, instead of using NHANES data. Approximately 20 to 25 food product categories are used almost entirely as ingredients in other foods.[11]
- Fresh foods sold as random weight appear to be underrepresented in Nielsen Homescan data even when the appropriate projection factors are applied; thus,

[10]The differences between purchases and consumption would be even larger if one accounted for the fact that some purchases are used in recipes (e.g., apple pie) that are not reflected in the NHANES consumption data for that product category.

[11]Recipe files could be used to convert foods consumed in NHANES into individual ingredient quantities, but use of these files to estimate consumption of each food category used in recipes would be time and cost prohibitive.

adjustments to the purchase estimates for these product categories are needed. Whether this issue occurs using Nielsen Scantrack data still needs to be investigated.

Other issues may arise as the method is applied to all 217 food product categories. However, use of the data from Nielsen and NHANES will provide a useful starting point for developing more defensible estimates of consumer-level food loss.

4.4 REFERENCE

Muth, M.K., P.H. Siegel, and C. Zhen. 2007. "ERS Data Quality Study Design." Report prepared by RTI International for the U.S. Department of Agriculture, Economic Research Service, Washington, DC.

5 Recommendations for Full Study to Estimate Consumer-Level Food Loss

Estimation of consumer-level food loss factors can be based on a numerical estimation process but will require expert judgment to develop some of the required assumptions and to validate the reasonableness of the resulting estimates.

Based on the exploratory research conducted for this study, we recommend the following for a full study to estimate consumer-level food loss:

- Calculate initial estimates of purchases for each available food category using Nielsen Homescan data (or Nielsen Scantrack data) for selected years from 1998 through 2005[12] and estimates of initial consumption for each available food category using NHANES data for 1999–2000, 2001–2002, 2003–2004, and 2005–2006.
- Work with ERS staff members and others familiar with data on fresh foods to determine an adjustment process for Nielsen Homescan data (or Nielsen Scantrak data, if needed) to better reflect the total purchases of fresh foods.
- Convene a panel of experts familiar with food consumption data and analysis to (1) develop plausible estimates of loss factors for ingredients based on the foods in which these ingredients are typically used, (2) develop plausible estimates of the percentage of foods consumed from purchases at grocery stores versus at restaurants and other foodservice establishments, and (3) review the resulting estimates of consumer-level food loss to validate whether they are reasonable and whether relative values for different product categories are appropriate.

[12]Before 2004, ERS purchased only the data for the households that participated in the fresh foods panel for those years. The projection factors should make estimates comparable even if drawn from different size panels, but there may be some discontinuity in the calculated series.

ERS is also interested in determining whether or how consumer-level food loss factors have varied over time. Comparing the estimated losses based on the data for 1998 through 2005 will provide some indication of potential trends in food loss that could be used to extrapolate to earlier time periods. However, the trends over this short time period will likely be subtle if observable. An additional factor that has likely affected food loss is the trend toward increased consumption of foods away from home. By adjusting the proportion of foods consumed away from home based on trends in expenditures over time, the numerical method described in Section 4 could be used to generate estimates of consumer-level food loss in prior years.

Appendix A: Project Description and Interview Guide

Interviews with Kitchen Managers about Food Loss in Restaurants
PROJECT DESCRIPTION

RTI International is conducting a project for the USDA Economic Research Service (ERS) to learn more about types of food loss that occur at home and in restaurants and obtain estimates of the degree of loss that occur across different types of foods. As part of this study, we are conducting 30 minute telephone interviews with up to 21 kitchen managers at quick service/fast food, family dining and fine dining establishments. The purpose of the interviews is to understand sources and factors that influence food loss such as cooking losses, plate waste and discarded food at restaurants.

We are requesting your participation in an individual discussion for this project. Some of the topics of interest for the discussion include:

- What factors influence the amount of cooking loss?
- How does cooking loss vary by type of food?
    - Meat, fish and poultry
    - Dairy products
    - Fruits and vegetables
    - Grain or bread products
    - Fats and oils (including cooking fats and oils)
    - Sugars and sweeteners
- What factors influence the amount of plate loss? How does plate loss vary by type of food?
- What factors influence the amount of loss due to spoilage or discarding of unused food? How does loss due to spoilage vary by type of food?
- What other types of food loss occur in restaurants?

RTI is an independent, not-for-profit research organization located in Research Triangle Park, North Carolina. The sources of any information provided to RTI will be kept confidential, will not be revealed to USDA or to the public, and are not subject to access under the Freedom of Information Act. Your responses will be aggregated with other responses in our project with USDA.

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Discussion Guide for Estimating Food Loss in Restaurants

Background (if needed)

RTI International is conducting a project for the USDA's Economic Research Service (ERS) to learn more about types of food loss that occur at home and in restaurants and obtain estimates of the degree of loss that occur across different types of foods. As part of this study, we are conducting 30 minute telephone interviews with up to 21 kitchen managers at quick service/fast food, family dining and fine dining establishments. The purpose of the interviews is to understand sources and factors that influence food loss such as cooking losses, plate waste and discarded food at restaurants. The results of the study will be used by the USDA to develop better estimates of caloric consumption in the United States.

Food loss definition

Before we get started, food loss refers to the difference between what food is ordered or received by the restaurant and what is actually eaten. However, we are not trying to estimate the inedible portion of foods such as seeds, rinds and bones (USDA is doing this separately).

Food groups

The food groups that we are interested in assessing for food loss are:

- Meat, fish and poultry
- Dairy products
- Fruits and vegetables
- Grain and bread products
- Fats and oils (including cooking fats and oils)
- Sugars and sweeteners

1) How often do you order <insert food group>? In what units do you order <insert food group>?

Foods	***Order Amounts***	
	Frequency (days, weeks, months)	***Unit (package type)***
Meat, fish, and poultry		
Dairy products		
Fruits and Vegetables		
Grain and bread products		
Fats and oils (including cooking fats and oils)		
Sugars and sweeteners		

2a) What percentage of <insert food group> is lost thru <food loss factor>?

Food Loss Factors	***Foods***	
	Meat, fish, and poultry	***Dairy products***
Cooking Losses		
Spoilage in Storage		
Discard of Unused Foods		
Plate Waste		
Other		

2b) What percentage of <insert food group> is lost thru <food loss factor>?

Food Loss Factors	***Foods***	
	Fruits and Vegetables	***Grain and bread products***
Cooking Losses		
Spoilage in Storage		
Discard of Unused Foods		
Plate Waste		
Other		

2c) What percentage of <insert food group> is lost thru <food loss factor>?

Food Loss Factors	***Foods***	
	Fats and oils (including cooking fats and oils)	***Sugars and sweeteners***
Cooking Losses		
Spoilage in Storage		
Discard of Unused Foods		
Plate Waste		
Other		

Appendix B: Detailed List of Products from NHANES

Table B-1. NHANES Food Product Categories for Estimation of Consumption Quantities

Food Category	NHANES Food Category
Yogurt	Yogurt, NS as to type of milk or flavor
	Yogurt, plain, NS as to type of milk
	Yogurt, plain, whole milk
	Yogurt, plain, lowfat milk
	Yogurt, plain, nonfat milk
	Yogurt, vanilla, lemon, or coffee flavor, NS as to type of milk
	Yogurt, vanilla, lemon, or coffee flavor, whole milk
	Yogurt, vanilla, lemon, maple, or coffee flavor, lowfat milk
	Yogurt, vanilla, lemon, maple, or coffee flavor, nonfat milk
	Yogurt, vanilla, lemon, maple, or coffee flavor, nonfat milk, sweetened with low-calorie sweetener
	Yogurt, chocolate, NS as to type of milk
	Yogurt, chocolate, whole milk
	Yogurt, chocolate, nonfat milk
	Yogurt, fruit variety, NS as to type of milk
	Yogurt, fruit variety, whole milk
	Yogurt, fruit variety, lowfat milk
	Yogurt, fruit variety, lowfat milk, sweetened with low-calorie sweetener
	Yogurt, fruit variety, nonfat milk
	Yogurt, fruit variety, nonfat milk, sweetened with low-calorie sweetener
	Yogurt, fruit and nuts, NS as to type of milk
	Yogurt, fruit and nuts, lowfat milk
Peanut butter	Peanut butter
	Peanut butter, low sodium
	Peanut butter, reduced sodium
	Peanut butter, reduced fat
	Peanut butter, vitamin and mineral fortified
	Peanut butter and jelly
	Peanut butter sandwich
	Peanut butter and jelly sandwich
	Peanut butter and banana sandwich
Cane and beet sugar	Sugar, NFS
	Sugar, white, granulated or lump
	Sugar, white, confectioner's, powdered
	Sugar, brown
	Sugar, maple
	Sugar, cinnamon
	Sugar, raw

(continued)

Table B-1. NHANES Food Product Categories for Estimation of Consumption Quantities (continued)

Food Category	NHANES Food Category
Shortening	Shortening, NS as to vegetable or animal
	Shortening, vegetable
	Shortening, animal
Fresh apples	Apple, raw
	Apple, baked, NS as to added sweetener
	Apple, baked, unsweetened
	Apple, baked, with sugar
Fresh and frozen fish and shellfish	Fish, NS as to type, raw
	Fish, NS as to type, cooked, NS as to cooking method
	Fish, NS as to type, baked or broiled
	Fish, NS as to type, breaded or battered, baked
	Fish, NS as to type, floured or breaded, fried
	Fish, NS as to type, battered, fried
	Fish, NS as to type, steamed
	Fish stick, patty, or fillet, NS as to type, cooked, NS as to cooking method
	Fish stick, patty, or fillet, NS as to type, baked or broiled
	Fish stick, patty, or fillet, NS as to type, breaded or battered, baked
	Fish stick, patty, or fillet, NS as to type, floured or breaded, fried
	Fish stick, patty, or fillet, NS as to type, battered, fried
	Anchovy, cooked, NS as to cooking method
	Barracuda, cooked, NS as to cooking method
	Barracuda, baked or broiled
	Barracuda, floured or breaded, fried
	Barracuda, steamed or poached
	Carp, cooked, NS as to cooking method
	Carp, baked or broiled
	Carp, floured or breaded, fried
	Carp, steamed or poached
	Carp, smoked
	Catfish, cooked, NS as to cooking method
	Catfish, baked or broiled
	Catfish, breaded or battered, baked
	Catfish, floured or breaded, fried
	Catfish, battered, fried
	Catfish, steamed or poached
	Cod, cooked, NS as to cooking method
	Cod, baked or broiled

(continued)

Table B-1. NHANES Food Product Categories for Estimation of Consumption Quantities (continued)

Food Category	NHANES Food Category
Fresh and frozen fish and shellfish (cont.)	Cod, breaded or battered, baked
	Cod, floured or breaded, fried
	Cod, battered, fried
	Cod, steamed or poached
	Croaker, cooked, NS as to cooking method
	Croaker, baked or broiled
	Croaker, breaded or battered, baked
	Croaker, floured or breaded, fried
	Croaker, steamed or poached
	Eel, cooked, NS as to cooking method
	Eel, steamed or poached
	Flounder, raw
	Flounder, cooked, NS as to cooking method
	Flounder, baked or broiled
	Flounder, breaded or battered, baked
	Flounder, floured or breaded, fried
	Flounder, battered, fried
	Flounder, steamed or poached
	Haddock, cooked, NS as to cooking method
	Haddock, baked or broiled
	Haddock, breaded or battered, baked
	Haddock, floured or breaded, fried
	Haddock, battered, fried
	Haddock, steamed or poached
	Herring, raw
	Herring, cooked, NS as to cooking method
	Herring, baked or broiled
	Herring, floured or breaded, fried
	Herring, pickled, in cream sauce
	Mackerel, raw
	Mackerel, cooked, NS as to cooking method
	Mackerel, baked or broiled
	Mackerel, salted
	Mackerel, floured or breaded, fried
	Mullet, raw
	Mullet, cooked, NS as to cooking method
	Mullet, baked or broiled
	Mullet, floured or breaded, fried

(continued)

Table B-1. NHANES Food Product Categories for Estimation of Consumption Quantities (continued)

Food Category	NHANES Food Category
Fresh and frozen fish and shellfish (cont.)	Mullet, steamed or poached
	Ocean perch, raw
	Ocean perch, cooked, NS as to cooking method
	Ocean perch, baked or broiled
	Ocean perch, breaded or battered, baked
	Ocean perch, floured or breaded, fried
	Ocean perch, battered, fried
	Ocean perch, steamed or poached
	Perch, cooked, NS as to cooking method
	Perch, baked or broiled
	Perch, breaded or battered, baked
	Perch, floured or breaded, fried
	Perch, battered, fried
	Perch, steamed or poached
	Pike, cooked, NS as to cooking method
	Pike, baked or broiled
	Pike, floured or breaded, fried
	Pike, battered, fried
	Pike, steamed or poached
	Pompano, raw
	Pompano, cooked, NS as to cooking method
	Pompano, baked or broiled
	Pompano, floured or breaded, fried
	Pompano, battered, fried
	Pompano, steamed or poached
	Porgy, raw
	Porgy, cooked, NS as to cooking method
	Porgy, baked or broiled
	Porgy, breaded or battered, baked
	Porgy, floured or breaded, fried
	Porgy, battered, fried
	Porgy, steamed or poached
	Ray, cooked, NS as to cooking method
	Ray, baked or broiled
	Ray, floured or breaded, fried
	Ray, steamed or poached
	Salmon, raw
	Salmon, cooked, NS as to cooking method

(continued)

Table B-1. NHANES Food Product Categories for Estimation of Consumption Quantities (continued)

Food Category	NHANES Food Category
Fresh and frozen fish and shellfish (cont.)	Salmon, baked or broiled
	Salmon, floured or breaded, fried
	Salmon, battered, fried
	Salmon, steamed or poached
	Sea bass, cooked, NS as to cooking method
	Sea bass, baked or broiled
	Sea bass, breaded or battered, baked
	Sea bass, floured or breaded, fried
	Sea bass, steamed or poached
	Sea bass, pickled (Mero en escabeche)
	Shark, cooked, NS as to cooking method
	Shark, baked or broiled
	Shark, steamed or poached
	Smelt, cooked, NS as to cooking method
	Smelt, baked or broiled
	Smelt, floured or breaded, fried
	Smelt, battered, fried
	Smelt, steamed or poached
	Sturgeon, cooked, NS as to cooking method
	Sturgeon, baked or broiled
	Sturgeon, steamed
	Sturgeon, floured or breaded, fried
	Swordfish, cooked, NS as to cooking method
	Swordfish, baked or broiled
	Swordfish, floured or breaded, fried
	Swordfish, steamed or poached
	Trout, cooked, NS as to cooking method
	Trout, baked or broiled
	Trout, breaded or battered, baked
	Trout, floured or breaded, fried
	Trout, battered, fried
	Trout, steamed or poached
	Tuna, fresh, raw
	Tuna, fresh, cooked, NS as to cooking method
	Tuna, fresh, baked or broiled
	Tuna, fresh, floured or breaded, fried
	Tuna, fresh, steamed or poached
	Whiting, cooked, NS as to cooking method

(continued)

Table B-1. NHANES Food Product Categories for Estimation of Consumption Quantities (continued)

Food Category	NHANES Food Category
Fresh and frozen fish and shellfish (cont.)	Whiting, baked or broiled
	Whiting, breaded or battered, baked
	Whiting, floured or breaded, fried
	Whiting, battered, fried
	Whiting, steamed or poached
	Octopus, cooked, NS as to cooking method
	Octopus, steamed
	Octopus, dried
	Octopus, dried, boiled
	Roe, shad, cooked
	Roe, herring
	Roe, sturgeon
	Squid, raw
	Squid, baked, broiled
	Squid, breaded, fried
	Squid, steamed or boiled
	Abalone, cooked, NS as to cooking method
	Abalone, floured or breaded, fried
	Abalone, steamed or poached
	Clams, raw
	Clams, cooked, NS as to cooking method
	Clams, baked or broiled
	Clams, floured or breaded, fried
	Clams, battered, fried
	Clams, steamed or boiled
	Conch, battered, fried
	Conch, baked or broiled
	Crab, cooked, NS as to cooking method
	Crab, baked or broiled
	Crab, hard shell, steamed
	Crab, soft shell, floured or breaded, fried
	Crayfish, floured or breaded, fried
	Crayfish, boiled or steamed
	Lobster, cooked, NS as to cooking method
	Lobster, baked or broiled
	Lobster, without shell, steamed or boiled
	Lobster, floured or breaded, fried
	Lobster, battered, fried

(continued)

Table B-1. NHANES Food Product Categories for Estimation of Consumption Quantities (continued)

Food Category	NHANES Food Category
Fresh and frozen fish and shellfish (cont.)	Lobster, steamed or boiled
	Mussels, raw
	Mussels, cooked, NS as to cooking method
	Mussels, steamed or poached
	Oysters, raw
	Oysters, cooked, NS as to cooking method
	Oysters, baked or broiled
	Oysters, steamed
	Oysters, floured or breaded, fried
	Oysters, battered, fried
	Scallops, cooked, NS as to cooking method
	Scallops, baked or broiled
	Scallops, steamed or boiled
	Scallops, floured or breaded, fried
	Scallops, battered, fried
	Shrimp, cooked, NS as to cooking method
	Shrimp, baked or broiled
	Shrimp, steamed or boiled
	Shrimp, floured, breaded, or battered, fried
	Snails, cooked, NS as to cooking method
	Snails, steamed or poached
	Fish with cream or white sauce, not tuna or lobster (mixture)
	Crab, deviled
	Crab imperial
	Fish timbale or mousse
	Lobster newburg
	Lobster with butter sauce (mixture)
	Shrimp, curried
	Shrimp cocktail (shrimp with cocktail sauce)

NS = not specified

NFS = not further specified