

# Correction of Dietary Fat Availability Estimates for Wastage of Food Service Deep-Frying Fats<sup>1</sup>

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Because of the renewed interest in the consumption of hydrogenated fats, reliable estimates of the dietary fat available to the United States population require correction for the considerable amount of deep-frying fats used in food service operations that are discarded after use and thus are not available for consumption. We estimated this fat wastage from food service sources from published data on fat exchange during cooking and on numbers of specific entrees purchased away from the home by United States households. Among food items considered, fat rendered from hamburgers and chicken contributed substantially to the total gross fat available for discard; fried chicken, french fries and doughnuts accounted for a large portion of total fat uptake by foods. To calculate waste frying fat, expressed as a percent of net waste fat, we subtracted fat uptake by foods from the total visible frying fat available for usage and from the level of gross fat available for discard. Dividing the resulting values gave a percent waste frying fat of 60%. For calculation of fat available for consumption, we recommend that contributions from deep-frying fats be reduced by 50% of the total available to correct for wastage. This value is conservative and representative of actual experience of major food service operations and agrees closely with estimates derived from spent grease recovery reported in the United States.

**KEY WORDS:** Deep-frying fats, fat availability, fat wastage, food service fats.

Most estimates of intake of total fat or of individual fatty acids calculated from amounts of fat-containing foods available for consumption are too high because they fail to correct for fats that are deliberately discarded. Edible oil manufacturers who supply deep-frying fats to the food service industry have long known that a considerable amount of deep-frying fat is discarded after use and thus is not available for consumption. Because deep-frying fats contribute about 65% of total fat sold to United States food service operations (1), and because eating out at restaurants is increasingly widespread in this country, the wastage of deep-frying fats must be considered to calculate reliable estimates of total fat available to free-living populations. Prediction of reliable estimates of fat and of individual fatty acid intake by the United States population is useful to the edible oil industry, academia and government regulatory agencies. Such information is of particular value to health professionals who wish to assess diet/disease relationships and trends in consumption of specific nutrients as accurately as possible.

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The objective of this paper is to describe a rationale for reasonably estimating the amount of discarded deep-frying fat from food service operations to correct estimates of fat consumption based on available foods. The key point is: If fat is discarded, it is not available for consumption. We demonstrate how the total availability of deep-frying fats can be adjusted to more accurately reflect the availability of fat from food service sources.

As background, in developing our recently updated estimate of the level of *trans* fatty acids available for consumption in the United States diet (about 8 g/person/d) (1,2), we considered contributions from all major categories of retail, food service and industrial fats and oils. In the case of food service fats and oils, we adjusted our estimate of *trans* acid availability for 50% wastage of all deep-frying fats except for shortening used for frying doughnuts. This 50% estimate was derived from a market research survey of away-from-home eating (3). In the case of household or industrial usage of fats, we made no corrections for wastage because we believe that such wastage is small in comparison to deep-frying fat wastage by restaurants. This paper provides details about the market research survey of away-from-home eating practices, which represented the principal basis for our estimate of deep-frying fat wastage. We also will indicate how this estimate can be confirmed by considering the published values of the amount of restaurant waste fats collected annually by the rendering industry and independent grease dealers. As additional supporting evidence, we will discuss the edible oil industry's understanding of restaurant frying practices based on the industry's close working relationship with restaurants of all types. And finally, we will compare our estimate with the few values for fat wastage we have found in the literature.

*Survey of away-from-home eating practices.* The principal basis for our fat wastage estimate was a survey of away-from-home eating (3) conducted by the NPD Group Inc. (Park Ridge, IL), a market research company. Since the mid-1970s, the NPD Group has made a service they refer to as the "CREST Report" available to the food service industry. The term "CREST" is an acronym for Consumer Reports on Eating Share Trends. The service is a continuous study of the away-from-home eating behavior of consumers, and provides basic marketing data to the food service industry.

The methodology of the survey is as follows. Detailed diaries are kept by about 12,800 United States households, which record their restaurant visits and purchases of meals, snacks and beverages over two-week periods during each of the four seasons. The household sample is nationwide and targeted against Census Bureau demographic data to assure that it is representative of the United States population. Panelists are recruited by mail and are replaced at a rate of approximately 15–20% annually. As payment, after one year's participation panelists select a gift from a list of household items valued at \$25 to \$35. Completed diaries are mailed to the NPD

Group for evaluation. These data are weighted according to Census Bureau information on income, age of household head, household size and region, and then are projected to represent the United States household population of 91 million.

The resulting CREST Report consists of about 50,000 raw observations and/or transactions of consumer restaurant behavior every quarter. Examples of information included in the reports are customer traffic counts, check size, visit frequency and foods eaten. For the purpose of our analysis, we were interested in the total numbers of orders of specific food items.

To determine our estimate of frying fat wastage, we considered data on the numbers of orders of specific entrees from the 1988 CREST Report (3) and data on fat exchange by these foods during cooking. Fat exchange represents the fat rendered out of meat or other foods while they are being cooked, as well as fat taken up during cooking. Table 1 shows fat exchange data for typical orders of common meat entrees. These data came from various industry studies and published food composition tables (4-6). Combining these data with the numbers of orders from the CREST Report (3), we calculated the amount of fat available for discard from each food item. Among the food items shown, hamburgers and fried chicken contributed the largest amounts of fat exchanged. These data combined with the total visible frying fat sold to the food service industry, namely 1.58 billion pounds, account for the "gross fat available for discard," approximately 2.2 billion pounds.

Table 1 also shows fat uptake from the frying fat by various fried foods. Fried chicken, french fries and doughnuts accounted for a large proportion of total fat uptake, in part because of the large numbers of orders of these foods (3). The data for fried chicken have been adjusted to exclude uptake of chicken fat *per se* from the frying medium.

To calculate the percent waste fat from the frying fat, the amount of fat uptake was subtracted from the total amount of visible frying fat available to determine the amount of frying fat remaining after cooking, namely 890 million pounds. The fat uptake value also was subtracted from the level of gross fat available for discard to obtain the net waste fat available, 1.49 billion pounds. Dividing these two values gave a percent waste fat from frying fat of 60%. We used a somewhat more conservative estimate of 50% wastage for our calculations of *trans* acid availability from deep-frying fat (1,2). We made no correction for shortening used for frying doughnuts because in industry practice there is little wastage of doughnut frying shortening.

**Restaurant waste collections by the rendering industry.** Our estimate of fat wastage can be verified indirectly by considering that about 2.5 billion pounds of waste restaurant fats (including fat, water and food debris) are collected annually from restaurants and fast-food establishments in the United States by the rendering industry and independent grease dealers (7,8). This waste material is reprocessed into approximately 1.6 billion pounds of fat referred to as "yellow grease," which is incorporated into animal feeds and pet foods and used in certain industrial applications (e.g., as a source of fatty acids). The annual production of about 1.6 billion pounds of yellow grease is in good agreement with our figure for net waste fat

TABLE 1

## Origins of Food Service Waste Fat

Fat sources	Fat exchanged in typical order <sup>a</sup> (g)	Number of orders <sup>b</sup> (MM)	Total fat available (MMM lbs)
Visible frying fat <sup>c</sup>			1.581
Invisible fat			
Bacon/sausage	22	1160	0.056
Hamburger	8	12550	0.221
Beef entrees	8	1870	0.033
Tacos	8	870	0.015
Fried chicken	57	2160	0.271
Total invisible fat			0.596
Gross fat available for discard			2.177
Fat uptake (from frying fat) on food			
Fish sandwich	22	660	0.032
Chicken sandwich	10	980	0.022
Fried fish	32	1010	0.071
Fried shellfish	13	310	0.009
Fried chicken	35 <sup>d</sup>	2160	0.167
Chicken nuggets	10	1220	0.027
French fries	6	12245	0.162
Onion rings	16	580	0.020
Doughnuts	7	11500	0.177
Total fat uptake (from frying fat) on food			0.687
Net waste fat available			1.490
Percent waste fat from frying fat <sup>e</sup>			60%

<sup>a</sup>Data from References 4-6, nutrition information guides from Wendy's and Burger King and frying tests conducted by Institute of Shortening and Edible Oils (ISEO) member companies.

<sup>b</sup>Data from Reference 3.

<sup>c</sup>Data obtained from member companies of the ISEO (see also market size for deep-frying fats and oils, Table 3, Reference 2).

<sup>d</sup>Corrected for amount of chicken fat taken up from the frying medium.

<sup>e</sup>Calculated from the following equation:

$$\text{Percent waste fat from frying fat} = \frac{(\text{visible frying fat}) - (\text{fat uptake from frying fat on food})}{(\text{net waste fat available})} \times 100\%$$

available of 1.49 billion pounds. The agreement of these two wastage figures obtained independently adds further credibility to our 50% value for wastage of deep-frying fat.

**Restaurant frying practices: edible oil industry experience.** To determine whether our 50% estimate of deep-frying fat wastage is consistent with actual practice by restaurants, we obtained information on frying french fries and chicken from several member companies of the Institute of Shortening and Edible Oils. The information came from companies that manufacture and sell frying fats not only to major fast-food chains but also to sit-down restaurants. Because detailed information on frying practices by various restaurants is considered confidential, we will not identify the specific companies and restaurants that provided data. However, the data applicable to fast-food operations represent the experience of over 1000 restaurants nationwide.

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For perspective, according to the National Restaurant Association, there are approximately 500,000 restaurants currently in the United States (9,10). Of this number, about 80% (400,000) have deep fryers (11). Among those that serve deep-fried foods, about 38,000 are those of major fast-food chains with more than 1000 units, for example, McDonalds, Kentucky Fried Chicken, Burger King and Wendy's (12). The remaining 362,000 represent smaller chains and individual sit-down restaurants. Although major fast-food chains represent only about 12% of the restaurants with deep fryers, these chains purchase approximately 30–35% of all deep-frying fat sold to the food service industry. The remaining 65–70% of deep-frying fat is sold to the smaller chains, sit-down restaurants and various institutions, such as schools, hotels and hospitals.

It is widely recognized within the edible oil industry that frying practices differ markedly among restaurants. In general, high-volume fast-food restaurants serve large amounts of deep-fried foods, such as french fries and fried chicken, whereas nonfast-food operations deep-fry to a lesser extent. Because of the larger volume of deep-fried foods served by the major fast-food restaurants, more frying fat goes out with the food served, and thus more fat is added back to the fryer at the end of the day's operation than is the case for nonfast-food restaurants. Because most restaurants, including fast-food or nonfast-food types, discard their used frying fat after about 5–7 d of continuous usage, fast-food chains tend to discard less of the fat they purchase than nonfast-food restaurants.

Typical frying practices of major fast-food chains that serve a large volume of french fries and other foods are outlined in Table 2. Most restaurants purchase frozen french fries that have been lightly fried (a process referred to as "parfrying") and then refry them before serving them to customers. Parfried french fries typically contain about 7–8% fat, whereas finished french fries typically have about 14–15% fat. During frying there is fat exchange between the visible frying fat added to the

frying kettle and the parfry fat present in the frozen french fries. Considering that the proportions of added visible frying fat and parfry fat in the frying kettle change continuously during the frying operation, we have estimated that during a typical frying week, the average absorption (or removal) of visible frying fat into the food is about 30 g of fat per 1 pound batch of parfries.

Industry sales experience indicates that a typical major chain fast-food restaurant may fry as much as about 8000 pounds of parfries in a month. In such a case, the average uptake of visible fat by parfries could be up to 530 pounds per month. For many fast-food restaurants, french fries represent about 60–80% of their total fried food volume. We have estimated that visible fat uptake by other fried foods, for example fish fillets, chicken and onion rings, could be about 200 pounds per month. Thus, the total visible fat uptake by all fried foods could be over 700 pounds per month.

Because major fast-food restaurants may use up to about 1600 pounds of frying fat per month, and because over 700 pounds of frying fat go out of the restaurant absorbed into food, the amount of fat discarded is the difference, about 800 to 900 pounds per month. This discard does not consider the amounts of oil lost due to filtering and spillage. However, such losses are usually small compared to the amount of fat absorbed by the food. Overall, the amount of discard, expressed as a percentage of total fat usage, is about 50%.

Table 3 presents frying information representative of restaurants that fry a high volume of chicken. Edible oil industry experience indicates that these restaurants know, on average, how much frying fat to purchase depending on the sales of chicken they project. The restaurants also know how much frying fat typically is added back to the fryer. The difference between fat purchased and fat added back is discard, which, expressed as a percentage of fat purchased, is about 40–50%.

In the case of smaller chains and sit-down restaurants, which collectively represent about 90% of restaurants that

TABLE 2

Typical Frying Practices of Major Fast-Food Chains<sup>a</sup>

Average uptake visible fat  $\approx$  30 g fat/pound batch parfries (over 7-d period)

$$\text{Uptake visible fat/month (parfries)} \approx \frac{8000 \text{ lb parfries}}{\text{store-month}} \times \frac{30 \text{ g fat}}{\text{lb parfries}} \times \frac{1 \text{ lb}}{454 \text{ g}}$$

$$\approx 530 \text{ lb fat/month}$$

$$\text{Uptake visible fat/month (other foods)} \approx 200 \text{ lb fat/month}$$

$$\text{Total visible fat uptake} \approx 730 \text{ lb fat/month}$$

	Amount of fat (lb/store/month)
Average visible fat usage	1600
Visible fat uptake	730
Discard	870
$\% \text{ Discard} = \frac{870}{1600} \times 100\% = 54\%$	

<sup>a</sup>Source: Member companies of The Institute of Shortening and Edible Oils.

TABLE 3

Fat Wastage from Chicken Frying<sup>a</sup>

	Amount of fat (pounds/unit of chicken purchased)
Average fat usage	0.30
Average fat add-back	0.17
Discard	0.13

$$\% \text{ Discard} = \frac{0.13}{0.30} \times 100\% = 43\%$$

<sup>a</sup>Source: Member companies of The Institute of Shortening and Edible Oils.

do deep-frying, we know that fat wastage is considerably higher than in typical fast-food chains. This is because the nonfast-food restaurants usually have a much smaller volume of food going through their fryers than typical fast-food restaurants (*i.e.*, a lower turnover rate). Thus, comparatively speaking, much less frying fat is absorbed into food served at nonfast-food restaurants than at fast-food restaurants. The net result is that the nonfast-food restaurants discard a higher percentage of the fat they use. Edible oil industry representatives have estimated this level of fat wastage to be around 65–70%, based on fat sales to restaurants. This is in contrast to the estimated discard of about 40–50% for major fast-food chains, as we have discussed.

Overall, from these considerations we believe our estimate of 50% fat wastage is conservative and representative of the actual experience of major food service operations. In the future, however, this level of discard could increase if United States deep fryers adopt policies now in effect in some European Economic Community countries covering discard of frying fat based on levels of oxidation products in the used fat. In essence, adoption of similar regulations could mean more frequent discard of used frying fats by many restaurants than is now the case in the United States.

*Other published estimates of fat wastage.* Our review of the literature has indicated few estimates of fat wastage. Rizek and colleagues (13) at USDA's Human Nutrition Information Service reported that for 1980 fat wastage from fats and oils represented about 11 g out of 72 g in the total category, or about 15% of total fats and oils available for consumption. This estimate apparently was not solely restricted to deep-frying. We discussed this estimate with Rizek (private communication, 1991), and he told us that the 15% wastage figure was an undocumented estimate provided verbally to him by one industry representative about 10 or 11 years ago. Accordingly, we question the accuracy of this estimate, particularly as applied to current 1990s food service operations, and Rizek agreed with us. More recently, Enig and colleagues (14) claimed that fat discard for the fat used in frying french fries is about 10% and for the fat used in frying chicken, about 11–18%. The french fry fat wastage figure was based on their study of only one restaurant, and their chicken frying values were derived from information they obtained from a consultant. We believe that neither estimate is representative of current typical major fast-food restau-

TABLE 4

## Fat Uptake: Frying French Fries

Source	Fryer capacity (pounds of fat)	Add-back fat (pounds/week)
Enig <i>et al.</i> <sup>a</sup>	80	>500
Major fast-food chain experience <sup>b</sup>	50	40
Scaled-up estimate <sup>c</sup>	80	64

<sup>a</sup>Reference 14.

<sup>b</sup>Institute of Shortening and Edible Oils member companies.

<sup>c</sup>This paper.

edible oil industry is that fat wastage for frying either french fries or chicken is around 40–50% or higher.

The problem with the wastage value of Enig and co-workers (14) for frying french fries (Table 4) is that it is based on an unrealistically high level of add-back fat. Enig and co-workers (14) reported that the "moderately busy fast-food restaurant" that they studied added more than 500 lb of fat to an 80-lb fryer during a week to replace fat absorbed by french fries. On the other hand, industry experience with 50-lb fryers, which are commonly used by some major fast-food chains, indicates typical add-back of about 5½–6 lb of fat per day, or about 40 lb per week, to replace fat absorbed by french fries. Scaling up to an 80-lb fryer would increase this add-back fat to about 64 lb per week. Accordingly, we believe that the 500 lb per week of add-back fat reported by Enig and colleagues (14) is atypical and is simply not representative of most fast-food restaurant practices. Realistically, to absorb this amount of add-back fat would require frying of about 7500 lb of parfries per week in one fryer, which is about 4–5 times the typical practice of many major chain fast-food restaurants.

Based on all of these considerations, we conclude that about 50% (or more) of deep-frying fat used in food service operations is discarded after use and is not available for consumption. This value is probably conservative and is supported by a survey of away-from-home eating practices of United States households, estimates of spent grease recovery in the United States and actual experience of major food service operations. We recommend for calculation of fat and fatty acid consumption by the free-living United States population that contributions from deep-frying fats be reduced by at least 50% of the total available to correct for amounts ordinarily discarded.

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