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Analysis of consumption of home-produced foods

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One of the potential exposure pathways of concern when assessing human exposures to environmental contaminants is the ingestion of contaminated foods. Individuals who live near contaminated sites and who grow their own food may be at a higher risk than the general population. Estimating exposures to this subpopulation requires an analysis of homegrown food intake rates. The Nationwide Food Consumption Survey (NFCS) 1987–1988 data were used to generate intake rates for home-produced foods. Results of the analysis show that, among the general population, homegrown vegetables (18%) were the most commonly consumed of the major food groups, followed by fruit (8%), meat (5%), fish (2%), and dairy products (0.8%). The intake rates for the major food groups vary according to region, age, urbanization, and race. In general, intake rates of home-produced foods are higher among populations in non-metropolitan and suburban areas and lowest in central city areas. *Journal of Exposure Analysis and Environmental Epidemiology* (2001) **11,** 398–406.

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Introduction

Home-produced foods can become contaminated in various ways. Plants may become contaminated by deposition of pollutants from the air, absorption of pollutants that are dissolved in rainfall or irrigation waters, and absorption of pollutants by plant roots from contaminated soils and water. Meats and dairy products may become contaminated when animals grazing in these areas consume contaminated soil, water, or feed crops.

Farmers, as well as rural and urban residents who consume home-produced foods, may be potentially exposed if these foods become contaminated. For these populations, exposure *via* the consumption of home-produced foods may be a significant route of exposure (US EPA, 1989, 1996). Consumption of homegrown fruits, vegetables, game, and fish has been shown to have an impact on blood lead levels in areas where soil lead contamination exists (US EPA, 1994). Ingestion of homegrown foods has been considered a potential route of exposure at Superfund sites where soil contamination is found (US EPA, 1991, 1993). Assessing exposures to individuals who consume home-produced foods requires the knowledge of intake rates of such foods. For the purposes of this study, home-produced foods were defined as homegrown fruits, vegetables, meat, and dairy products derived from consumer-raised livestock, game meat, and home-caught fish.

Until 1988, USDA conducted the NFCS every 10 years to analyze the food consumption behavior and dietary status of Americans (USDA, 1992). The NCFS 1987–1988 survey was conducted between April 1987 and August 1988. In 1987–1988, there were two components of the NFCS. The household component collected information based on a recall of food used over a 7-day period. The survey included information on the socioeconomic and demographic characteristics of households, and the types, amount, value, and sources of foods that were brought into the household and used for consumption (USDA, 1994). An important and unique aspect of this survey is that respondents identified if the food was home-produced or not. Although USDA has conducted food consumption surveys in recent years, they do not include information on home-produced foods. The individual intake component collected information on food intakes at home and away from home of individuals within each household over a 3-day period (USDA, 1993). The survey used a statistical sampling technique designed to ensure that all seasons, geographic regions of the 48 conterminous states in the US, and socioeconomic and demographic groups were represented (USDA, 1994). The sample size for the 1987–1988

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survey was approximately 4300 households (over 10,000 individuals).

Methods

The food items/groups selected for analysis included the following major food groups: total fruits, total vegetables, total meats, total dairy, total fish, and shellfish. Food items/groups were identified in the NFCS database according to NFCS-defined food codes. Intake rates were not calculated for food items/groups for which less than 30 households reported home-produced usage because the number of observations may be inadequate for generating distributions that would be representative of that segment of consumers. The USDA data were adjusted by applying the sample weights calculated by USDA to the data set prior to analysis. The USDA sample weights were designed to adjust for survey non-response and any underrepresentation of demographic groups, and to account for unequal numbers of interviews in different calendar months or on different days of the week (USDA, 1987–1988a). Also, the USDA weights were calculated "so that the weighted sample total equals the known population total, in thousands, for several characteristics thought to be correlated with eating behavior" (USDA, 1987–1988a).

Although the individual intake component of the NFCS gave the best measure of the amount of each food item eaten by each individual in the household, it could not be used directly to measure consumption of home-produced food because the individual component did not identify the source of the food item (i.e., as home-produced or not) (USDA, 1987–1988b). Therefore, an analytical method, which incorporated data from both the household and individual survey components, was developed to estimate individual home-produced food intake. The USDA household data were used to determine (1) the amount of each home-produced food item used during a week by household members and (2) the number of meals eaten in the household by each household member during a week. The household survey reported the total amount of each home-produced food item used in the household (whether by guests or household members). The amount of home-produced food used by household members was derived by multiplying the total amount of home-produced food used in the household by the proportion of all home-produced meals served in the household (during the survey week) that were consumed by household members.

The individual survey data were used to generate average sex- and age-specific serving sizes for each food item (USDA, 1987–1988b). The term "serving size" in this manuscript refers to the amount eaten per eating occasion. This value is estimated by adding the meal size, including snacks, among individuals in an age group category and then dividing it by the total number of meals. Serving size data or amount eaten per eating occasion is necessary to apportion the amount of home-produced food eaten by each individual. The age categories used in the analysis were as follows: 1–2 years, 3–5 years, 6–11 years, 12–19 years, 20–39 years, 40–69 years, and over 70 years. Intake rates were not calculated for children under 1 year because their diet differs markedly from that of other household members, and thus, the assumption that all household members share all foods would be invalid for this age group. The estimated serving sizes for these groups were used during subsequent analyses to generate homegrown food intake rates for individual household members. Individual intakes of home-

Table 1. Percent losses for various food groups.

Food group	Mean percent cooking losses (range of means)	Mean percent post-cooking losses (range of means)
Meats[a]	30[b] (27 to 33)	25[c] (10 to 36)
Fish and shellfish[d]	32[b] (−19 to 94)	11[c] (1 to 26)
Fruits	21[e] (10 to 29)	31[f] (25 to 36)
Vegetables[g]	15[h] (−12 to 28)	22[i] (1 to 33)

[a]Averaged over various cuts and preparation methods for various meats including beef, pork, chicken, turkey, lamb, and veal.
[b]Includes dripping and volatile losses during cooking.
[c]Includes losses from cutting, shrinkage, excess fat, bones, scraps, and juices.
[d]Averaged over a variety of fish and shellfish, including: bass, bluefish, cod, flounder, haddock, halibut, lake trout, mackerel, perch, porgy, red snapper, rockfish, salmon, sea trout, shad, smelt, sole, spot, squid, swordfish steak, trout, and whitefish, clams, crab, crayfish, lobster, oysters, and shrimp and shrimp dishes.
[e]Based on preparation losses. Averaged over apples, pears, peaches, strawberries, and oranges. Includes losses from removal of skin or peel, core or pit, stems or caps, seeds, and defects.
[f]Averaged over apples and peaches. Includes losses from draining cooked forms.
[g]Averaged over various vegetables including: asparagus, beets, broccoli, cabbage, carrots, corn, cucumbers, lettuce, lima beans, okra, onions, green peas, peppers, pumpkins, snap beans, tomatoes, and potatoes.
[h]Includes losses due to paring, trimming, flowering the stalk, thawing, draining, scraping, shelling, slicing, husking, chopping, and dicing and gains from the addition of water, fat, or other ingredients. Averaged over various preparation methods. Excludes dehydrated forms of potatoes.
[i]Includes losses from draining or removal of skin. Based on potatoes only.

Table 2. Consumer-only intake of homegrown fruits (g/kg-day).

Population group	N_c wgtd	N_c unwgtd	%Consuming	Mean	SE	P25	P50	P90	P95	P99	P100
Total	14,744,000	817	8	2.7	0.19	0.50	1.1	5.9	11	24	61
Age (years)											
1–2	360,000	23	6	8.7	3.1	1.6	3.5	19	61	61	61
3–5	550,000	34	7	4.1	1.5	0.98	1.9	6.0	8.9	48	48
6–11	1,044,000	75	6	3.6	0.68	0.70	1.3	12	16	32	32
12–19	1,189,000	67	6	1.9	0.37	0.44	0.66	6.8	8.3	19	19
20–39	3,163,000	164	5	2.0	0.33	0.37	0.70	4.2	6.8	16	37
40–69	5,633,000	309	10	2.7	0.30	0.47	1.0	5.8	13	24	53
70+	2,620,000	134	17	2.3	0.23	0.61	1.2	5.2	8.7	12	15
Season											
Fall	3,137,000	108	7	1.6	0.16	0.57	1.0	3.5	5.0	11	11
Spring	2,963,000	301	6	1.6	0.14	0.42	0.86	4.1	5.1	8.1	32
Summer	4,356,000	145	10	3.9	0.64	0.45	1.3	11	15	53	61
Winter	4,288,000	263	9	3.1	0.34	0.56	1.2	8.0	15	25	48
Urbanization											
Central city	3,668,000	143	7	2.3	0.26	0.57	1.1	5.3	11	14	19
Non-metropolitan	4,118,000	278	9	2.4	0.31	0.45	1.2	4.5	8.3	24	53
Suburban	6,898,000	394	8	3.1	0.32	0.49	0.99	7.3	15	37	61
Race											
Black	450,000	20	2	1.9	0.85	0.61	1.1	2.3	2.3	19	19
White	14,185,000	793	9	2.7	0.19	0.51	1.1	6.1	12	24	61
Response to questionnaire											
Households who garden	12,742,000	709	19	2.8	0.21	0.53	1.1	6.1	12	25	61
Households who farm	1,917,000	112	26	2.6	0.26	0.75	1.6	6.0	7.8	16	16

SE=standard error; P=percentile of the distribution; N_c wgtd=weighted number of consumers; N_c unwgtd=unweighted number of consumers in survey.

produced food were calculated for all members of the survey population by using the quantity of each homegrown food item/group used by the family, the number of meals consumed by each individual, and the mean sex- and age-specific serving size for each family member. Individual intake rates were calculated using the following general equation:

$$w_i = W_f \left[\frac{m_i q_i}{\sum_{i=1}^{n} m_i q_i} \right] \quad (1)$$

where: w_i=homegrown amount of food item/group attributed to member i during the week (g/week); W_f=total quantity of homegrown food item/group used by the family members (g/week); m_i=number of meals of food consumed by member i during the week (meals/week); and q_i=serving size for an individual within the age and sex category of the member (g/meal).

This model assumes that the serving size for a particular home-produced food item is the same as the serving size for the same food item which was obtained from the individual component of the NFCS 1987–1988 survey and that includes foods from all sources. The model apportions the amount eaten by each individual in the household by taking the ratio of the numbers of meals eaten by each individual times the average serving size for an individual of the same age and gender divided by the sum of the number of meals eaten by each member of the family times the average serving size for each individual at the age group and gender. The data on the number of meals used in this model represent all meals eaten regardless of their source. This approach was necessary because the survey does not provide data on the percentage of each meal that is home-produced. The model is essentially assuming that the percentage of each meal that is home-produced is similar for all members of the household. In reality, the percentage of the meal that was home-produced may vary from 0% to 100%. The effect that this limitation has on the result is

minimized by the fact that the ratio of the meals is taken. Daily intake of a homegrown food item/group for each individual in the survey was determined by dividing the weekly value (w_i) by seven. Intake rates were indexed to the self-reported body weight of the survey respondent and were reported in units of g/kg day. For the major food groups (fruits, vegetables, meats, dairy, and fish), distributions of home-produced intake among consumers were generated for the entire data set and according to the following subcategories: age groups, urbanization categories, seasons, and race. Although not included in the results presented here, analyses were also conducted for the various regions of the US (i.e., Northeast, Midwest, South, and West) (US EPA, 1997). In addition, intakes were generated for those households that indicated being engaged in gardening, farming, fishing, or raising animals. Consumers were defined as members of survey households who reported consumption of the food item/group of interest during the 1-week survey period. The percentage of intake that was homegrown was also calculated as the ratio of total intake of the homegrown food item/group by the survey population to the total intake of all forms of the food by the survey population.

Percentiles of average daily intake derived from short time intervals (e.g., 7 days) will not, in general, be reflective of long-term patterns. This is especially true regarding consumption of many homegrown products (e.g., fruits, vegetables), where there is often a strong seasonal component associated with their use. Deriving long-term distribution of average daily intakes requires knowledge about within-person variability over time (Buck et al., 1995). In the absence of these data, exposure assessors commonly assume that this variability is small (Slob, 1993; Buck et al., 1997). Following this presumption, an individual who consumes at a particular percentile level for the season in which the individual was surveyed is assumed to consume at that same percentile level during other seasons of the year. For example, an individual who reported a high consumption of meat during the survey period would be assumed to have a high consumption of

Table 3. Consumer-only intake of homegrown vegetables (g/kg-day).

Population group	N_c wgtd	N_c unwgtd	%Consuming	Mean	SE	P25	P50	P90	P95	P99	P100
Total	34,392,000	1855	18	2.1	0.07	0.45	1.1	5.2	7.5	16	27
Age											
1–2	951,000	53	17	5.2	0.85	1.2	3.3	13	20	27	27
3–5	1,235,000	76	15	2.5	0.28	0.71	1.3	6.4	7.7	11	13
6–11	3,024,000	171	18	2.0	0.25	0.40	0.9	4.6	6.2	18	24
12–19	3,293,000	183	16	1.5	0.14	0.32	0.8	3.7	6.0	7.7	9
20–39	8,593,000	437	14	1.5	0.10	0.27	0.8	3.4	4.9	11	21
40–69	12,828,000	700	23	2.1	0.10	0.53	1.2	5.1	6.9	15	23
70+	4,002,000	211	25	2.5	0.19	0.58	1.4	6.4	8.2	13	16
Seasons											
Fall	11,026,000	394	23	1.9	0.13	0.41	1.0	4.9	6.9	13	19
Spring	6,540,000	661	14	1.4	0.07	0.32	0.70	3.4	5.2	8.4	24
Summer	11,081,000	375	24	2.9	0.19	0.71	1.6	7.0	9.8	19	27
Winter	5,745,000	425	12	1.8	0.11	0.47	1.1	3.9	6.0	11	21
Urbanization											
Central city	6,183,000	228	11	1.4	0.12	0.30	0.75	3.8	4.7	10	17
Non-metropolitan	13,808,000	878	31	2.7	0.12	0.60	1.5	6.4	9.3	18	27
Suburban	14,341,000	747	17	1.8	0.09	0.39	1.0	4.3	6.8	13	21
Race											
Black	1,872,000	111	9	1.8	0.23	0.44	0.93	4.7	5.7	8.2	19
White	31,917,000	1714	20	2.1	0.07	0.45	1.1	5.2	7.7	16	27
Response to questionnaire											
Households who garden	30,217,000	1643	44	2.2	0.07	0.48	1.2	5.4	7.7	15.5	24
Households who farm	4,319,000	262	59	3.3	0.25	0.85	1.7	8.9	11.8	17.6	24

SE=standard error; P=percentile of the distribution; N_c wgtd=weighted number of consumers; N_c unwgtd=unweighted number of consumers in survey.

Table 4. Consumer-only intake of homegrown meats (g/kg-day).

Population group	N_c wgtd	N_c unwgtd	%Consuming	Mean	SE	P25	P50	P90	P95	P99	P100
Total	9,257,000	569	5	2.2	0.11	0.66	4.9	4.9	6.8	14	23
Age (years)											
1–2	276,000	22	5	3.6	0.61	1.2	8.7	8.7	10	12	12
3–5	396,000	26	5	3.6	0.51	2.1	7.8	7.8	9.1	13	13
6–11	1,064,000	65	6	3.7	0.45	1.3	8.0	8.0	14	15	15
12–19	1,272,000	78	6	1.7	0.17	0.62	3.7	3.7	4.3	6.8	7.5
20–39	2,732,000	158	4	1.8	0.15	0.53	4.5	4.5	6.2	9.2	11
40–69	2,872,000	179	5	1.7	0.11	0.58	3.7	3.7	5.2	5.9	7.5
70+	441,000	28	3	1.4	0.23	0.55	2.8	2.8	3.6	7.4	7.4
Season											
Fall	2,852,000	107	6	1.6	0.14	0.52	3.2	3.2	4.4	6.8	7.8
Spring	1,726,000	197	4	2.4	0.15	0.78	5.0	5.0	6.7	10	13
Summer	2,368,000	89	5	3.1	0.38	0.85	7.0	7.0	11	22	22
Winter	2,311,000	176	5	2.0	0.17	0.65	4.0	4.0	6.4	11	23
Urbanization											
Central city	736,000	28	1	1.2	0.18	0.44	2.7	2.7	3.4	3.6	3.6
Non-metropolitan	4,932,000	315	11	2.7	0.18	0.75	6.1	6.1	8.5	15	23
Suburban	3,589,000	226	4	1.8	0.10	0.68	3.7	3.7	4.7	7.2	10
Race											
Black	128,000	6	0.6	**	**	**	**	**	**	**	**
White	8,995,000	556	6	2.3	0.11	0.68	5.0	5.0	7.0	14	23
Response to questionnaire											
Households who garden	5,256,000	343	52	2.8	0.15	1.0	5.9	5.9	7.8	14	23
Households who farm	3,842,000	243	52	2.9	0.19	0.89	6.1	6.1	8.0	14	23

SE=standard error; P=percentile of the distribution; N_c wgtd=weighted number of consumers; N_c unwgtd=unweighted number of consumers in survey.
**Intake data not provided for subpopulations for which there were less than 20 observations.

meat during other seasons of the year. To try to derive, for the major food categories, the long-term distribution of average daily intake rates from the short-term data available, an approach was developed, which attempted to account for seasonal variability in consumption using this basic assumption. This approach used regional "seasonally adjusted distributions" to approximate regional long-term distributions and then combined these regional-adjusted distributions (in proportion to the weights for each region) to obtain a US-adjusted distribution, which approximated the US long-term distribution. It is recognized that some bias may be introduced by virtue of the assumptions used in the analysis. However, more research in deriving long-term distributions from short-term data is necessary to fully understand the impact of this bias.

The percentiles of the seasonally adjusted distribution for a given region were generated by averaging the corresponding percentiles of each of the four seasonal distributions of the region. Specifically, the seasonally adjusted distribution for each region is such that its inverse cumulative distribution function is the average of the inverse cumulative distribution functions of each of the seasonal distributions of that region. The use of regional seasonally adjusted distributions to approximate regional long-term distributions is based on the assumption that each individual consumes at the same regional percentile levels for each season and consumes at a constant weekly rate throughout a given season. Thus, for instance, if the 60th percentile weekly intake level in the South is 14.0 g in the summer and 7.0 g in each of the three other seasons, then an individual in the South with an average weekly intake of 14.0 g over the summer would be assumed to have an intake of 14.0 g for each week of the summer and an intake of 7.0 g for each week of the other seasons.

The intake data presented here for consumers of home-produced foods and the total number of individuals surveyed may be used to calculate the mean and the percentiles of the distribution of home-produced food

consumption in the overall population (consumers and non-consumers) as follows.

Assuming that IR is the homegrown intake rate of food item/group at the pth percentile and N_c is the weighted number of individuals consuming the homegrown food item, and N_T is the weighted total number of individuals surveyed, then $N_T - N_c$ is the weighted number of individuals who reported zero consumption of the food item. In addition, there are $(p/100 \times N_c)$ individuals below the pth percentile. Therefore, the percentile that corresponds to a particular intake rate (IR_p) for the overall distribution of homegrown food consumption (including consumers and non-consumers) can be obtained by:

$$p^{\text{th}}_{\text{overall}} = 100 \times \frac{\left(\frac{p}{100} \times N_c + (N_T - N_c)\right)}{N_T} \quad (2)$$

where

$$N_T = \frac{N_c}{\%\text{Consuming}} \quad (3)$$

As mentioned earlier, the individual intake rates derived in this section are based on the amount of food that was brought into the household and available for consumption. As measured by the NFCS, the amount of food "consumed" by the household is a measure of consumption in an economic sense, i.e., a measure of the weight of food brought into the household that has been consumed (used up) in some manner. In addition to food being consumed by persons, food may be used up by spoiling, by being discarded (e.g., inedible parts), through cooking processes, *etc.* USDA estimated preparation losses for various foods (USDA, 1975). For meats, a net cooking loss, which includes dripping and volatile losses, and a net post-cooking loss, which involves losses from cutting, bones, excess fat, scraps, and juices, were derived for a variety of cuts and cooking methods. For total meats, these losses have been averaged across all meat types, cuts, and cooking methods to obtain a mean net cooking loss and a mean net post-cooking loss. For fish and shellfish, fruits and vegetables, USDA (1975)

Table 5. Consumer-only intake of home-caught fish (g/kg-day).

Population group	N_c wgtd	N_c unwgtd	%Consuming	Mean	SE	P25	P50	P90	P95	P99	P100
Total	3,914,000	239	2	2.1	0.00	0.43	1.0	4.7	7.8	16	45
Age (years)											
1–2	82,000	6	1	**	**	**	**	**	**	**	**
3–5	142,000	11	2	**	**	**	**	**	**	**	**
6–11	382,000	29	2	2.8	0.01	0.55	1.0	7.1	7.9	25	25
12–19	346,000	21	2	1.5	0.00	0.31	0.98	4.7	6.7	8.4	8.4
20–39	962,000	59	2	1.9	0.00	0.44	1.1	4.5	9.6	13	13
40–69	1,524,000	86	3	1.8	0.00	0.35	0.99	4.4	6.6	11	16
70+	450,000	24	3	1.2	0.00	0.57	0.76	3.7	3.7	5.1	5.1
Season											
Fall	122,000	45	3	1.3	0.00	0.32	0.92	2.6	3.7	6.6	6.6
Spring	1,112,000	114	2	3.1	0.01	0.56	1.3	6.7	11	37	45
Summer	911,000	29	2	1.9	0.00	0.30	0.76	4.4	5.7	9.6	9.6
Winter	671,000	51	1	2.1	0.00	0.51	1.1	5.9	7.9	13	13
Urbanization											
Central city	999,000	46	2	1.8	0.00	0.61	1.1	3.7	9.6	9.6	16
Non-metropolitan	1,174,000	94	3	3.2	0.01	0.57	1.9	6.5	7.8	37	45
Suburban	1,741,000	99	2	1.5	0.00	0.29	0.59	4.4	7.1	11	13
Race											
Black	593,000	41	3	1.8	0.00	0.32	0.98	16	16	16	16
White	3,228,000	188	2	2.1	0.00	0.39	1.0	5.0	6.7	16	45
Response to questionnaire											
Households who fish	3,553,000	220	9	2.2	0.00	0.47	1.1	5.6	7.9	16	45

SE=standard error; P=percentile of the distribution; N_c wgtd=weighted number of consumers; N_c unwgtd=unweighted number of consumers in survey.
**Intake data not provided for subpopulations for which there were less than 20 observations.

Table 6. Consumer-only intake of home-produced dairy (g/kg-day).

Population group	N_c wgtd	N_c unwgtd	%Consuming	Mean	SE	P25	P50	P90	P95	P99	P100
Total	1,409,000	89	0.8	14	1.6	3.2	10	34	44	73	111
Age (years)											
1–2	79,000	6	1	**	**	**	**	**	**	**	**
3–5	57,000	5	0.7	**	**	**	**	**	**	**	**
6–11	264,000	16	2	**	**	**	**	**	**	**	**
12–19	84,000	5	0.4	**	**	**	**	**	**	**	**
20–39	612,000	36	1	7.4	1.0	1.9	6.5	15	20	23	23
40–69	216,000	16	0.4	**	**	**	**	**	**	**	**
70+	77,000	3	0.5	**	**	**	**	**	**	**	**
Season											
Fall	211,000	7	0.4	**	**	**	**	**	**	**	**
Spring	253,000	27	0.6	18	4.3	5.1	12	51	80	111	111
Summer	549,000	22	1	15	2.7	5.4	11	35	37	47	47
Winter	396,000	33	0.8	8.1	2.0	0.74	5.5	20	20	73	73
Urbanization											
Central city	115,000	7	0.2	**	**	**	**	**	**	**	**
Non-metropolitan	988,000	59	2	17	2.1	6.7	11	35	44	80	111
Suburban	306,000	23	0.4	9.9	2.4	0.57	5.4	28	29	51	51
Race											
Black	0	0	0	**	**	**	**	**	**	**	**
White	1,382,000	86	0.9	14	1.7	3.8	10	34	44	80	111
Response to questionnaire											
Households who raise animals	1,228,000	80	12	16	1.7	6.1	11	35	44	80	111
Households who farm	1,020,000	63	14	17	2.0	9.1	12	35	44	80	111

SE=standard error; P=percentile of the distribution; N_c wgtd=weighted number of consumers; N_c unwgtd=unweighted number of consumers in survey.
**Intake data not provided for subpopulations for which there were less than 20 observations.

also gave cooking and post-cooking losses. These data are presented in Table 1. The following formulas can be used to convert the intake rates tabulated here to rates reflecting actual consumption:

$$I_A = I(1 - L_1)(1 - L_2) \quad (4)$$

$$I_A = I(1 - L_p) \quad (5)$$

where: I_A=adjusted intake rate; I=tabulated intake rate; L_1=cooking loss; L_2=post-cooking loss; and L_p=paring or preparation loss.

For fruits, corrections based on post-cooking losses only apply to fruits that are eaten in cooked forms. For raw forms of the fruits, paring or preparation loss data should be used to correct for losses from removal of skin, peel, core, caps, pits, stems, and defects, or draining of liquids from canned or frozen forms.

Results

The intake rate distributions (among consumers) for total home-produced fruits, vegetables, meats, fish, and dairy products are shown, respectively, in Tables 2–6. Also shown in these tables is the proportion of respondents consuming the item during the (1-week) survey period. Homegrown vegetables were the most commonly consumed of the major food groups (18%), followed by fruit (8%), meat (5%), fish (2%), and dairy products (0.8%). The intake rates for the major food groups vary according to season, age, urbanization, and race. In general, intake rates of home-produced foods are higher among populations in non-metropolitan and suburban areas and lowest in central city areas. Homegrown intake was generally higher among individuals who indicated that they operate a farm, grow their own vegetables, raise animals, and catch their own fish. The results of the seasonal analyses for all regions

Table 7. Seasonally adjusted consumer-only homegrown intake (g/kg-day).

Population group	%Consuming	P25	P50	P90	P95	P99	P100
Total vegetables							
Northeast	17	0.20	0.46	3.3	5.7	8.8	10
Midwest	33	0.29	0.81	4.4	7.4	1.3	20
South	24	0.21	0.61	4.0	5.6	12	16
West	24	0.11	0.49	3.0	5.0	8.9	11
All regions	25	0.22	0.64	4.0	6.1	12	20
Total fruit							
Northeast	4	0.17	0.36	1.5	3.0	5.1	5.6
Midwest	13	0.14	0.79	5.8	9.5	22	27
South	8	0.38	0.95	6.7	10	15	16
West	18	0.29	0.69	4.8	8.5	15	18
All regions	10	0.25	0.75	5.6	9.1	18	27
Total meat							
Northeast	6	0.13	0.21	1.6	1.9	4.1	4.8
Midwest	9	0.05	1.6	5.3	7.5	12	14
South	6	0.19	0.53	3.8	5.0	8.5	9.5
West	10	0.24	0.56	2.3	3.4	7.2	9.1
All regions	7	0.22	0.66	4.1	5.2	9.4	14

combined indicated that, in general, homegrown fruits and vegetables were eaten at a higher rate in summer, and home-caught fish were consumed at a higher rate in spring. Seasonally adjusted intake rate distributions for total vegetables, total fruits, and total meats are presented in Table 7.

Discussion

The USDA NFCS data set is the largest publicly available source of information on consumption on home-produced foods in the United States. The advantages of using this data set are that it is expected to be representative of the US population and that it provides information on a wide variety of food groups. However, the data collected by the USDA NFCS are based on short-term dietary recall and the intake distributions generated from them may not accurately reflect long-term intake patterns, particularly with respect to the tails (extremes) of the distributions. The two survey components (i.e., household and individual) do not define food items/groups in a consistent manner; as a result, some errors may be introduced into these analyses because the two survey components are linked. The results presented here may also be biased by assumptions that are inherent in the analytical method utilized. The analytical method may not capture all high-end consumers within households because average serving sizes are used in calculating the proportion of homegrown food consumed by each household member. Thus, for instance, in a two-person household where one member had high intake and one had low intake, the method used here would assume that both members had an equal and average level of intake. In addition, the analyses assume that all family members consume a portion of the home-produced food used within the household. However, not all family members may consume each home-produced food item and serving sizes allocated here may not be entirely representative of the portion of household foods consumed by each family member. The preparation loss factors presented in Table 1 are intended to convert intake rates based on "household consumption" to rates reflective of what individuals actually consume. However, these factors do not include losses to spoilage, feeding to pets, food thrown away, *etc.* It should also be noted that because this analysis is based on the 1987–1988 NFCS, it may not reflect recent changes in food consumption patterns. The low response rate associated with the 1987–1988 NFCS (i.e., 38% for the household survey and 31% for the individual survey) also contributes to the uncertainty of the homegrown intake rates generated using these data (USDA, 1993).

The data presented here for consumers of home-produced foods represent average daily intake rates of food items/groups over the 7-day survey period and do not account for variations in eating habits during the rest of the year; thus, the percentiles and the percent

consuming presented in Tables 2–6 (except the seasonally adjusted) are more appropriate when considering exposures over time periods of about 1 week. In contrast, the seasonally adjusted percentiles are designed to represent a long-term distribution of average daily intake and the percentage consuming shown with this distribution is designed to estimate the percent of the population consuming at any time during a year. Since the tabulated percentiles reflect the distribution among consumers only, Eqs. (2) and (3) must be used to convert the percentiles shown in Tables 2–7 to ones valid for the general population. As mentioned earlier, it is recognized that there are limitations regarding the assumptions used to estimate the long-term distribution and that further research is necessary to test the impact of these assumptions. A comprehensive study, where individuals are surveyed many times over a long period of time, is necessary to fully understand the issues regarding the estimation of long-term distributions from short-term measurements and to improve the accuracy of the analysis.

The analysis presented here provides valuable insights about the consumption of home-produced foods. Despite the limitations described above, the Nationwide Food Consumption Survey (NFCS) 1987–1988 household data used in this analysis is the only national data set available that provides information about the use of home-produced foods in the US. As stated earlier, this pathway may be the most significant for farmers, rural and urban residents consuming homegrown products that may have become contaminated.

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