Summary of Monday, October 28, 2002 Session
Exposure and Biomarkers Working Group

I. Overall Preliminary Research Priorities Identified by the Exposure and Biomarkers Group

The Exposure and Biomarkers Group (The Group) reviewed the available information and preliminary estimates of potential consumer exposures to acrylamide and determined the information that is critical to evaluating the significance of acrylamide found in foods. The Group identified the following items as the highest research priorities in the area of exposure assessment:

1. Expand the database of acrylamide levels in US foods through a clearinghouse for data and through collection of additional data to fill gaps.
2. Establish the relationship between biomarkers such as hemoglobin (Hb) adducts and acrylamide in foodstuffs. This research should include completion of the proposed Centers for Disease Control and Prevention (CDC) study of both acrylamide and glycidamide and of an on-going human study assessing the relationship between oral administration of acrylamide and the levels of Hb adducts of acrylamide and glycidamide.
3. Determine the bioavailability of acrylamide found in selected foods in appropriate animal or human studies.
4. Determine glycidamide levels in foods that also contain high concentrations of acrylamide.

II. Summary of available information about acrylamide levels in foods

The amount of information about acrylamide levels in foods is limited. There are virtually no data available for foods in the United States. The descriptions of the foods and the preparation methods for foods from other geographic regions are inadequate to allow reliable extrapolation to the US food supply. Table 1 summarizes the available public data, which are extremely limited. The mean (arithmetic and geometric) and median are presented along with the number of samples and the range of values reported. Specifically, small numbers of samples have been analyzed and these represent only a limited number of foodstuffs. The foodstuffs analyzed to date represent only a subset of the types of processing and cooking methods that foods undergo before consumption. These values should be regarded as range-finding estimates for acrylamide levels as the samples that have been analyzed are not representative of the food supply. To date no systematic, statistically designed data collection has been reported either in the United States or elsewhere. The samples have not been selected by processing characteristics (e.g. amount of time or temperature). Also, there has been no review of the quality of the available data or confirmation of findings. The level of detail available for samples varies widely (some samples were reported by broad category, others by the specific food item). For some categories there are only 1 or 2 samples; even the category with the most reported samples were represented by fewer than 100 analyses. FDA has undertaken the analysis of many more foods and has recently presented summary information for the available results.

III. Strategies for collection of data about acrylamide levels in food and potable water

Given the large numbers of foods that need to be evaluated, random sampling will be inefficient. Stratified/targeted sampling approaches are recommended therefore, and should consider:

- The most commonly consumed foods.
- Contributors to exposure for selected populations (children) with consumption patterns that differ from the general population.
- Foods with the highest levels of acrylamide (and also to identify those foods that are not contributing significant amounts).
- Foods with key precursors, such as foods that contain high levels of asparagine and reducing sugars and are heated above the minimum temperatures for acrylamide formation.
- Information to confirm that foods that are not processed do not have acrylamide.
- Categories of foods with high 'within-group' variation in acrylamide levels (that could inform decisions regarding the sources of exposure); incorporate information about key ingredients as well as cooking and processing methods; and where possible identify ingredients that are contributing significant amounts of acrylamide but that might not be classified separately as a "food." For example some flavor systems might be potential sources and should be evaluated.
- Non-food sources of dietary acrylamide should be explored. For example, the presence of acrylamide monomer residuals in water from use of polyacrylamide as a flocculating agent (residual monomer could be present as levels up to 0.05% of the polyacrylamide).

Given the lack of knowledge and the complexity of the question, research aimed at developing information to describe the national baseline exposure to acrylamide is the highest priority. Ideally, on-going research will identify key parameters that can be used to predict acrylamide levels or to facilitate the grouping of foods for analysis. Possible parameters include the presence of precursors, pH, processing temperatures and times, etc.

It was recognized by The Group that a California Statute (Proposition 65) may impede full disclosure of data by some food producers.

Realistically, a baseline exposure assessment will have to rely on limited data and a strategy is needed to ensure that the data provide adequate information. The WG concluded that this will be most efficiently achieved by focusing on the most important contributors to potential variation in exposure. Foods that are highly consumed by various subpopulations or subgroups should also be sampled in order to evaluate potential differences in exposure for different subpopulations. The range of processing and cooking procedures needs to be included – either through sufficient sampling of foods "as consumed," or through controlled processing and cooking studies. Depending on the results of research on the formation of acrylamide in foods, certain classes of foods that are not subject to high heat during processing may be assumed to contain no acrylamide. This would avoid the conventional conservative approach of assigning a concentration level equal to the limits of detection and quantification of the analytical method to foods without detectable levels.

Levels of acrylamide in drinking and processing water need to be determined so total dietary exposure can be better estimated. In assessing food's contribution to total exposure (and to biomarkers of exposure, as they are developed and examined in the population), it is necessary to characterize non-food exposures as well.

Recognizing that data will be generated by a number of different laboratories, a high priority is to quickly establish a baseline of critical information needed to interpret the acrylamide levels found in foods and to ensure quality and reliability of the data. For example, this would include documentation of the analytical methods, a full description of the food, identification of ingredients, parameters of the processing methods of that food (time/temperature/pH, etc.), and cooking steps. Criteria for evaluating the quality of the data will also facilitate the interpretation of the results and allow the data to be correctly utilized.

The most important variables include both exposure to low levels of acrylamide in commonly consumed foods and exposure from less frequently consumed foods with much higher acrylamide levels. A research study based on sampling foods following a market basket approach is recommended provided that foods are carefully selected for inclusion[1]. Specifically, The Group recommended that foods to be analyzed should be selected by

(1) utilizing food consumption data for the target population and subpopulations to stratify food consumption patterns into commonly consumed foods (considering both quantity and frequency of consumption) and then
(2) using available data on likely acrylamide concentrations, as well as potential ranges of acrylamide within similar foods, to define categories and to determine the relative numbers of samples for each food category and to assist in selecting "representative foods. " For example, to determine that white bread is the most frequently consumed bread so within the bread category more data will be required for white bread than for less frequently consumed types of bread. (The number of samples required will also depend on how variable acrylamide levels are found to be within a food-type category or sub-category.) More samples are needed to characterize levels in food types for which acrylamide levels vary substantially among sub-types [*e.g.* , different styles of bread]. This approach will also provide the information needed to determine the most appropriate surrogate for foods with similar preparation methods. Even within less frequently consumed categories a limited number of samples need to be collected to ensure that a category with significant levels of acrylamide is not overlooked. This additional data may also provide valuable insight into the impact of different types of processing on acrylamide.

In addition to using data on the mechanisms of formation to guide sampling protocols, the data may be useful to allow data collected for one category of foods to be adjusted to reflect changes

[1] The existing FDA TDS may need to be modified to reflect significant variability in acrylamide in foods.

in acrylamide due to processing/cooking. The use of frequency of different preparation methods in producing or preparing food will also be valuable.

Research on mechanisms of formation is a critical need. However, The Group recommended that baseline exposure studies should proceed with the available information rather than waiting for more extensive research on mechanisms of formation.

In conducting the baseline exposure analysis, sufficient numbers of samples should be collected to allow estimation of central tendencies as well as to provide a general indication of potential ranges of levels (and hence potential ranges of consumer exposure).

Variation in free asparagine levels due to cultivar differences, for instance, is likely important in determining exposure in the American diet. In developing the national baseline, sampling should be designed to cover as much as possible the spectrum of food products in each food category. Subsequent evaluations are likely to be needed for those food categories that contribute significantly to exposure to obtain adequate precision.

Country-specific data on acrylamide levels in foods was identified as extremely important since foods with the same name may include different ingredients, different plant varieties within those ingredients, and may have been produced using different processing parameters and/or cooking techniques. For example, The Group discussed differences in foods produced in Europe versus the US, such as potato chips (crisps).

The Group considered preliminary exposure assessments. These assessments incorporated the publicly available acrylamide levels in foods and information about consumption of those foods by US consumers. Exposure estimates based on the geometric mean acrylamide levels were 0. 02 mg/day (per capita) and 0. 2 mg/day (per consumer). Preliminary data from a European market basket study indicated total intake to be in a similar range to the conclusions of the FAO/WHO Consultation (June 2002). Virtually all of the currently available information about acrylamide levels is for foods available in European markets including potato chips and fries, breads, biscuits, crackers, cookies, cereals, coffee, nuts, seeds and nut butters. These food products may not be representative of food products in US markets. The Group also expressed concern that the available descriptions may not have allowed proper alignment of the acrylamide data with US food consumption data.

The categories of foods contributing most to exposure in these assessments also provide significant proportions of consumer's energy, protein, fat and fiber intake. There are many food categories, however, for which no data were available. The Group expressed concern that although utilizing data for acrylamide levels in foods in one geographic region and food consumption for a population in another region may be useful for initial range finding; it may also lead to erroneous conclusions. Therefore, it should be the highest priority to obtain acrylamide levels in foods that are relevant for US consumers.

IV. Epidemiology Data

The Group discussed the available epidemiology data to determine whether this information might be useful for assessing the levels of exposure. In a study of occupational exposure in China in a factory manufacturing acrylamide and polyacrylamide from acrylonitrile, substantial adduct levels derived from acrylamide, glycidamide and acrylonitrile were detected in exposed workers. There are limitations in the utility of this data as well as other similar epidemiological research in considering acrylamide in foods. Two endpoints were evaluated in epidemiological research on acrylamide exposures and potential effects, carcinogenicity and neurotoxicity. In spite of relatively large numbers of workers in the largest study, the power of the studies to detect small differences was low and the studies did not provide conclusive evidence of a link between acrylamide and cancer. Exposure of workers was primarily from dermal and inhalation routes and may not be applicable to exposure to acrylamide in foods. Nonetheless, the data provide some evidence that any potential effects due to levels in foods would be extremely small since even the high exposures noted in the occupational setting do not produce clear evidence of effects.

No epidemiological research is available for children.

A very large European epidemiological study currently underway, was reviewed for its potential utility in estimating acrylamide exposures. The European Prospective Investigation into Cancer and Nutrition (EPIC), which was initiated in 1992, studies 520,000 people in ten countries: Denmark, France, Italy, Germany, Greece, the Netherlands, Norway, Spain, Sweden and the United Kingdom. Detailed information on diet and lifestyle are obtained by questionnaire. Blood samples are drawn and stored in liquid nitrogen for future analyses. Acrylamide exposures were estimated using food consumption information collected for the EPIC study populations across Europe, and data on acrylamide from the Swedish government. Although the estimates are preliminary and based on limited data on acrylamide levels, the range of exposures was consistent with those reported for the US and at the FAO/WHO Consultation. Representatives of the EPIC study noted that the heterogeneity in food consumption practices across countries in Europe could contribute to the understanding of acrylamide risk factors. Analysis of the dietary data collected in the EPIC study will also allow an understanding of the different food sources of exposure in different countries.

The Group had significant concerns that the ability to draw valid conclusions from case-control and other population studies of associations between dietary sources of acrylamide and disease will be extremely limited and the potential for false conclusions relatively high. Limitations include (1) confounding variables including high fat/high calorie associations with foods thought to contain the highest levels of dietary acrylamide, lifestyle differences among control and subject populations, and the impact of diet on many disease states; (2) the occupational exposure studies did not show any strong associations and the levels of acrylamide exposure through the diet are lower than those experienced in the occupational studies; and (3) at the present time it is unclear what are the most appropriate health endpoints.

Biomarkers that accurately reflect acrylamide intake are essential for this type of work.

V. Bioavailability

The bioavailability of acrylamide in food is uncertain. Because of known bolus effects on the degree of metabolic transformation, and because of acrylamide's ability to bind to macromolecules, there is reason to suspect that bioavailability from the food matrix may be different from that of the media used in toxicology testing (air, water, and dermal uptake). However, there is some evidence that the population at large has detectible levels of Hb-acrylamide adducts, and limited evidence for Hb-adducts of the glycidamide epoxide metabolite. Whether these adducts are widespread in the US population, and if so, how they vary with age, ethnicity, diet, etc. is unknown. To date, there is no firm evidence as to the source of the acrylamide that has been measured in blood as adducts. These adducts may be useful as biomarkers of exposure with further research.

Existing studies indicate that acrylamide is absorbed through the digestive tract and can be detected as hemoglobin adducts; metabolites and other adducts have been measured in urine and other tissues. There are not sufficient data available to correlate acrylamide levels in food with any of these biomarkers at this time. Such information is critical to the evaluation of the significance of acrylamide in food.

The use of urinary biomarkers was discussed as a potential means of estimating the bioavailability of acrylamide in foods.

Additional research is required to determine the most appropriate measures of bioavailability and in particular the relationship between markers in human tissues versus those in experimental animals and any differences that would be anticipated as a result of the route of exposure (inhalation, dermal or dietary).

VI. Biomarkers

There has been extensive work in animals on biomarkers for acrylamide exposures. Several categories of biomarkers have been studied, including Hb adducts of acrylamide and glycidamide, DNA adducts, plasma acrylamide, urinary metabolites and protein adducts. The Group was informed of an on-going study in which human volunteers are receiving ^{13}C-acrylamide in order to define the relationship between oral exposures and Hb adducts of acrylamide and glycidamide.

The Hb adducts will reflect longer term exposure since binding is irreversible; plasma and urinary acrylamide adduct levels likely will reflect shorter term exposure. The possibility of using hair as a biomarker was discussed but the use of polyacrylamide in cosmetic products could confound the interpretation of results.

No research has been conducted conclusively linking any biomarker to typical dietary exposures to acrylamide in humans. This is a high priority for research. There is an upcoming study of human Hb adduct levels (as part of the next CDC NHANES study) that may provide extremely important information. Blood samples collected in the NHANES study will be analyzed during 2003.

The question of potential endogenous formation of acrylamide was raised but no data are currently available to address the issue.

VII. Non-food sources of acrylamide

Acrylamide monomer residual occurs in polyacrylamide formulations up to 0. 05%. Polyacrylamide is used in waste water treatment and occasionally in water treatment (less frequently today in the US than previously). Polyacrylamide is used in cosmetics to achieve the desired product viscosity. A major use of polyacrylamide is in the production of paper. For example, there are indirect additive approvals for the use of polyacrylamide in food contact papers. The EU conducted an assessment in 2000 that concluded that there was very little exposure to acrylamide through the environment.

Dermal absorption has been studied and is in the range of 10% in rodents (range of 3-30%).

VIII. Exposure assessment

The Group reviewed several exposure assessments in order to understand the general range of exposures and considered the proportion of the food supply that might contain some acrylamide. Based on guidance from the Toxicology Working Group, The Group considered the types of assessments that should be conducted including the time periods for the assessments (acute versus long term exposures) and the subgroups of concern.

In addition to the results reported in the FAO/WHO, 2002 Consultation report, exposure assessments for the U. S. population and the European EPIC study were discussed. The U. S. population exposure estimates were based on US food consumption data and on primarily European acrylamide levels in similar types of foods. Preliminary results from research conducted by the Swiss government suggest that total dietary intake of acrylamide is in the same range as that predicted from the preliminary exposure assessments based on levels in foods for which data available. The Group concluded that additional data are required to allow reliable exposure assessment since there are many food groups for which no data are available. Even where data are available, there are few samples and little explanation for the observed variations. The Group discussed possible sources of variation such as different types of products, different processing methods, different ingredients, different analytical methods, etc. The US FDA is planning to analyze food samples collected in upcoming market baskets for its Total Diet Study.

The Group concluded that additional data collection should be prioritized based on food consumption practices. Information about acrylamide levels should emphasize foods that are contributing most to the diet (e.g. most frequently consumed foods). Foods that may have particularly high levels of acrylamide should also be evaluated. The Group noted that information about how foods are cooked/prepared is available within US food consumption surveys and that it would be useful to organize information about food consumption into categories based on practices that would affect acrylamide levels (e.g. frying versus boiling).

At the request of the Methods Working Grou, The Group discussed the impact of lowering the limit of detection of the analytical methods on the resulting estimates of consumer exposure. The Group concluded that the desired limit of detection may be different for different food categories since some foods have levels that are readily detected with the current methodology. Foods that are not anticipated to contain measurable acrylamide may need to be assigned a value and the lower the limit of detection of the method, the lower the value that would typically be assigned. Thus The Group anticipated that the limit of detection of the analytical method would have an important impact on the estimates of exposure. Where acrylamide is not detected, it may be appropriate to assign some foods an arbitrary acrylamide level. This level could range from "zero" to the limit of determination value. Research will be needed to identify those foods that would not have acrylamide and for which a true "zero" could be applied in conducting the exposure assessment versus those for which some value might be appropriate. In general, analytical methods that provide sensitivity down to 10-20 ppb seemed reasonable for the purposes of exposure assessment[2].

A. Subpopulations

In the context of acrylamide in food, the toxicity endpoints of most concern are those that arise from long-term low-level exposures, such as carcinogenesis. For these endpoints, the Group concluded that the available food consumption data for U. S. population estimates of exposure simulate total lifetime exposure. In order to reflect lifetime exposure, it is necessary to capture the higher exposure during childhood years as well as the exposures during adult years. Lifetime exposure estimates can be determined for US consumers by utilizing all of the respondents in the USDA Continuing Survey of Food Intake for Individuals (CSFII). The CSFII is a statistically representative sample of the dietary patterns of all age groups and the combined dataset becomes representative of a full lifetime of exposure.

In evaluating potential reproductive effects, such as effects on spermatogenesis, exposures for adult males and females should be estimated for the appropriate time frames.

For all assessments, acrylamide levels should be estimated for the most frequently consumed foods. The Group recommended that the top foods (in terms of consumption) be identified for relevant subgroups and that the appropriate acrylamide levels be assigned to these foods for estimating exposure.

B. Time Frame

In the context of food, exposure assessment needs to be conducted for time frames ranging from a few weeks to lifetime. Given the nature of food consumption data, this will be accomplished by averaging over the available data of consumption or by

[2] The Group recognized that the limits will likely be problematic under the conditions of California's Proposition 65.

incorporating estimates of the frequency of consumption to provide average daily intakes over the appropriate time frame.

C. Variability/uncertainty

Based on available information, there will be a range of concentrations of acrylamide within a particular food and across food; likewise the food consumption patterns vary among individuals and for the same individual across days. There is also a great deal of uncertainty in the currently available information. It will be important to include measures of both variability and uncertainty in the evaluation of data and to understand the impact on conclusions drawn from the data. Variability and uncertainty measurement should be considered in the design of proposed acrylamide research.

1. Variability in acrylamide levels in foods

The data that are currently available were generally not collected in a way that allows analysis by processing/cooking method. Several governments have reported limited studies in which select foodstuffs were cooked for longer period of time. Based on those studies it appears that prolonged cooking increases acrylamide levels, in some cases dramatically. In a study in the UK, potato chips were cooked for an extended period of time after which the levels of acrylamide increased from 3,500 ppb to 12,800 ppb. Many of the food samples that were collected from the marketplace contained measurable amounts of acrylamide. As can be seen from Table 1, acrylamide values vary among product categories and within categories. However, inadequate information is available to adequately characterize the variation or to allow reliable prediction of acrylamide levels by processing procedure. The Group noted that there are likely to be large differences in levels in foods in different geographic regions.

2. Variability/uncertainty in food consumption, total exposure and sources of exposure

The contribution of any food or food category to acrylamide exposure will be a result of several factors, including amounts of acrylamide, frequency of consumption and amounts consumed. Foods that are frequently consumed, particularly those that are consumed in substantial quantities (e.g. staple foods) and that contain measurable levels of acrylamide will have the potential to contribute significant amounts to overall exposure of acrylamide.

No reliable conclusions could be drawn from the available data. Further, the contribution of individual foods will vary among populations and within individuals in a population and on different days for different individuals. Given the broad range of foods thought to contain acrylamide, the daily exposures will likely vary less than would be the case for a food constituent that is present in only a limited number of foods. The source of exposure will likely vary from individual to individual and for the same individual from day to day.

The Group reviewed information from Europe and from the U. S. on food consumption patterns and noted the large heterogeneity in foods consumed and the cooking/processing that foods have undergone prior to consumption; these differences may have a significant impact on acrylamide exposures.

IX. Potential impact on nutrition/health benefits of foods

The food categories analyzed to date include staple foodstuffs and therefore represent significant components of virtually all consumers' diets (Tables 2, 3). These categories contribute more than a third of the caloric intake for US consumers (Table 4).

Modifications to these foods may result in changes in the nutritional value (i. e. deep-fat frying at lower temperatures would be anticipated to result in increased uptake of fat in the food). The possibility of increased risks of food-borne pathogens due to changes in processing procedures was also noted by The Group.

In all evaluations, there is a need to assess the impact of any guidance on the resulting changes in nutritional status and food safety.

X. Conclusions

There is insufficient information to reliably estimate levels of acrylamide in foods, the bioavailability of acrylamide in food or the resulting consumer intake of acrylamide. More importantly, there is currently insufficient information to allow meaningful decisions to be made regarding changes that would reduce exposures. In order to provide a sound basis for decision-making, the following research is needed:

1. *Develop representative data on acrylamide levels in the US food supply*

There is a critical need for a comprehensive dataset describing acrylamide in foods. There is also a need to determine whether glycidamide can be formed in foods. The levels of acrylamide in foods will be utilized, along with national food consumption data to estimate the total exposure as well as to identify the most important sources of dietary exposure. The Group recognized that while some data may be available now, a large effort will need to be undertaken to fill data gaps. The Group recommended that resources be prioritized such that data will first be collected for those foods most frequently consumed, and that foods frequently consumed by children be specifically included as the highest priority.

It is anticipated that data collection and exposure estimation will be an iterative process as data are generated and exposure assessments revised.

Data are needed that will facilitate the understanding of variables that affect acrylamide levels in foods including processing, cooking, and consumer practices that could affect total exposure to acrylamide.

2. Encourage data sharing and easy access to all available data

Since it is anticipated that data will be generated by many different groups in industry, government and academia, an extremely high priority should be to develop a new clearinghouse for the data, or contribute to an existing clearing house, that will facilitate information sharing and also ensure that the results are adequately described and documented.

3. Determine bioavailability of acrylamide in food matrices

At the same time that information is collected about acrylamide and glycidamide levels in food, research must be conducted to determine the extent to which acrylamide found in food is bioavailable.

4. Establish relationships between dietary acrylamide and tissue biomarkers

Biomarkers are needed to assist in interpreting the impact of acrylamide levels in food on potential risks to consumers. Specifically, baseline studies are needed to correlate acrylamide intakes through the diet to biomarker levels (for the appropriate time periods, e.g. to reflect dietary intakes). Appropriate biomarkers for food exposure sources may be different than for occupational exposures. The Group recommends that initial studies be conducted to correlate hemoglobin adducts of acrylamide and glycidamide with dietary exposures.

Table 1. Acrylamide levels in different foods and food product groups from Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the United States of America

	Arithmatic Mean (ug/kg)	Geometric Mean (ug/kg)	Median (ug/kg)	Minimum-Maximum	Number of Samples	Data sources					
						CSPI	Norway	Netherlands	Sweden	Switzerland	UK
Bread	44	36	30	12-510	112		X	X	X	X	
French Fries	615	284	320	<50-12,000	86	X	X	X	X	X	X
Potato Chips	1188	931	1105	<60-3,100	92	X	X	X	X	X	X
Biscuit/Cookie	206	125	85	<30-2,000	76		X	X	X	X	
Crisp Bread	651	233	176	<30-4,000	36		X		X		X
Cereal	241	141	167	<30-1,346	45	X	X		X	X	X
Corn Chips	171	116	162	10. 6-385	6	X			X		
Pop Corn	416	416	416	416	1				X		
Battered Fried Products	43	41	39	30-64	4				X		
Fried Potato	282	221	225	20-2,000	48		X			X	
Coffee (roasted bean)	210	185	215	110-310	7					X	
Coffee beverage	15	14	15	<10-20	5					X	

Table 2. Consumption information for all food groups examined

Food Category	Percentage of US Population Consuming Food	NLEA Serving Size	Mean Consumption Per Eating Occasion	Mean Per Capita Consumption (g/day) 2-day Ave	Mean Per User[3] Consumption (g/day) 2-day Ave
Fries	28%	70 g	93. 4	16. 1	56. 7
Potato Chips	18%	30 g	41. 9	4. 5	25. 5
Cereal	41%	15g, 30g, 55g	49. 1	15. 9	38. 5
Yeast Breads and Rolls	88%	50g	65. 9	74. 2	83. 9
Baked Potato	8%	140 g	128. 5	4. 63	69. 1
Salty Snacks	30%	30 g	55. 1	11. 4	38. 2
Cookies	31%	30 g	39. 2	9. 0	28. 8
Fried Potato	4%	70 g	113. 4	2. 4	60. 6
Fried Breaded Meat	27%	85 g	110. 1	19. 9	74. 9
Crackers	24%	30 g	26. 4	4. 3	18. 1
Quick Breads	36%	50g	78. 6	20. 8	57. 0
Fried Fruits & Veggies	3%	85 g	110. 5	2. 0	62. 2
Cakes	19%	55g, 80g, 125g	89. 1	10. 7	55. 2
Fried pastry	8%	55 g	76. 9	3. 8	45. 4
Bars	4%	40 g	40. 7	1. 1	27. 2
Nuts Seeds Butters	4%	2 tbsp (~32 g)	54. 4	1. 4	31. 8
Coffee (liquid)	45%	240 ml	448. 1	249. 3	561. 5
Total: All Foods	99%				

[3] User defined as having consumed on at least 1 day of the survey.

Table 3. Nutrient intakes from broad CSFII food categories: All foods

Food Group (1 digit level)	Calories	Contribution To Average Total Daily Calorie Intake	Protein (g/day)	Contribution To Average Total Daily Protein Intake	I. Fat (g/day)	Contribution To Average Total Daily Fat Intake	Fiber (g/day)	Contribution To Average Total Daily Fiber Intake
Meat, Poultry Fish and Mixtures	385. 4	20%	33. 1	45%	21. 3	29%	1. 1	8%
Grain Products	677. 3	35%	0. 1	0%	20. 4	28%	6. 4	43%
Sugars, Sweets, and Beverages	262. 9	13%	1. 0	1%	1. 2	2%	0. 3	2%
Sugars and Sweets	66. 24	3%	0. 4	1%	0. 1	0. 1%	0. 05	0. 3%
NonAlcoholic Beverages	153. 2	8%	0. 4	1%	1. 1	2%	0. 2	1%
Alcoholic Beverages	43. 42	2%	0. 2	0. 3%	0. 009	0. 01%	0. 096	1%
Milk	224. 2	11%	11. 5	16%	10. 7	15%	0. 2	1%
Vegetables	174. 8	9%	4. 1	6%	7. 4	10%	3. 6	24%
Fruits	90. 64	5%	1. 0	1%	0. 5	1%	1. 7	11%
Fats, Oils, and Salad Dressing	60. 7	3%	0. 1	0%	6. 4	9%	0. 01	0. 1%
Dry beans, peas, other legumes, nuts and seeds	48. 34	2%	2. 2	3%	2. 6	4%	1. 3	9%
Eggs	31. 87	2%	2. 066	3%	2. 3	3%	0. 02	0. 1%
All CSFII Foods	1956		74		73		15	

Table 4. Nutrient analyses for foods analyzed for acrylamide categories 2-day average per capita

Food Category	Calories	Contribution To Average Total Daily Intake	Protein (g/day)	Contribution To Average Total Daily Intake	Fat (g/day)	Contribution To Average Total Daily Intake	Fiber (g/day)	Contribution To Average Total Daily Intake
Fries	41	7%	0. 5	3%	2. 1	9%	0. 5	8%
Potato Chips	22	4%	0. 3	2%	1. 4	6%	0. 2	3%
Cereal	59	9%	1. 3	7%	0. 6	2%	1. 0	18%
Yeast Breads and Rolls	201	32%	7. 6	40%	5. 4	24%	2. 1	36%
Baked Potato	6	1%	0. 1	1%	0. 1	1%	0. 1	2%
Salty Snacks	46	7%	1. 0	5%	2. 2	1%	0. 5	9%
Cookies	40	6%	0. 5	3%	1. 6	7%	0. 2	4%
Fried Potato	5	1%	0. 1	0. 4%	0. 3	1%	0. 1	1%
Fried Breaded Meat	50	8%	4. 4	23%	2. 7	12%	0. 1	1%
Crackers	20	3%	0. 4	2%	0. 7	3%	0. 1	2%
Quick Breads	60	10%	1. 5	8%	2. 2	10%	0. 5	8%
Fried Fruits Veggies	4	1%	0. 1	0. 3%	0. 3	1%	0. 04	1%
Cakes	38	6%	0. 4	2%	1. 4	6%	0. 1	2%
Fried pastry	15	2%	0. 2	1%	0. 9	4%	0. 1	1%
Bars	4	1%	0. 1	0. 5%	0. 1	1%	0. 04	1%
Nuts Seeds Butters	8	1%	0. 3	2%	0. 7	3%	0. 1	2%
Coffee (liquid)	6	1%	0. 3	2%	0. 05	0. 2%	0. 001	0. 02%
Total: All Swedish Foods	626		19		23		6	