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Health Canada's Revised Exposure Assessment of Acrylamide in Food

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Bureau of Chemical Safety
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Canada 

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Data Collected as part of the Acrylamide Monitoring Program

In 2009, Health Canada initiated a broader [acrylamide monitoring program](#) to provide a more up to date and accurate estimate of dietary exposure to acrylamide in Canada, assess the potential risk from acrylamide exposure and monitor the effectiveness of any reduction strategies which may have been implemented by industry. Health Canada completed phase 1 of the program in 2009 which included acrylamide testing results in bread (toasted and untoasted), coffee, French fries, cereals, snack foods, baby foods and many other food commodities. In 2010, Health Canada completed phase 2 of the monitoring program, which was designed to include samples from more food brands, capture additional generic brand names and include more samples from commodities that have shown highly variable acrylamide levels.

This new data has enabled Health Canada to set a “new baseline” for occurrence of acrylamide in various foods and serves as a basis upon which its assessment of dietary exposure to acrylamide can be based and updated regularly.

[The cumulative results from phases 1 and 2 of Health Canada's acrylamide monitoring program are included in Appendix 1](#). Note that the data presented in Appendix 1 represent only a certain proportion of the products that are available on the Canadian market and do not represent all brands and product types. No particular inference should be drawn from the presence or absence of any brand from this survey.

The data in [Appendix 1](#) are presented as the levels of acrylamide in the food when the food is in a prepared, ready-to-consume form. Where possible, foods were prepared according to manufacturers' specific instructions concerning cooking times, cooking temperatures, dilution factors, etc. Acrylamide concentrations in instant coffee, grain beverage, cocoa, infant formula and dry cereal samples were measured in the dry powder. However, acrylamide levels for instant coffee and grain beverage samples are presented in Appendix 1 after applying a dilution factor based on the amounts of powder and water used to prepare the beverage. Toasted bread was prepared with a cafeteria belt toaster. Light, medium, and dark toasting levels were determined empirically and correspond to the settings used to generate the respective levels of browning.

Dietary Exposure Assessment

Prior to the establishment of the acrylamide monitoring program, Health Canada had conducted a limited number of small surveys to determine the levels of acrylamide in certain food commodities. Using this data, a [preliminary exposure assessment](#) was conducted. The mean adult exposure to acrylamide from food was estimated to be between 0.3 and 0.4 micrograms per kilogram body weight per day ($\mu\text{g}/\text{kg}$ bw per day). The preliminary assessment used mean acrylamide concentration values for each

commodity and mean food consumption figures to calculate a single exposure value for the population, rather than a range of values, in what is called a deterministic assessment. The results of Health Canada's preliminary deterministic exposure assessment are similar to other deterministic dietary acrylamide exposure estimates conducted in other countries such as Sweden and the United States.

Using the much larger database of acrylamide occurrence data in foods collected in Canada as part of phases 1 and 2 of the acrylamide monitoring program and food consumption figures from the [Canadian Community Health Survey \(CCHS\) – Cycle 2.2 on Nutrition](#) (Statistics Canada, 2004), Health Canada used computer modeling to conduct a probabilistic dietary exposure assessment for acrylamide. A probabilistic exposure assessment combines all of the individual contaminant concentrations measured in samples of each particular food along with individual consumption data from the CCHS for the same foods. Specifically, an acrylamide concentration for each food listed in [Appendix 1](#) was randomly applied to the relevant food consumption rates reported by each individual respondent in the CCHS. The result is a distribution of possible dietary exposures to the substance in question. Note that if acrylamide levels were reported as less than the analytical instrument's limit of detection (LOD), the level of acrylamide in the food was conservatively set to the LOD.

Whenever possible, market share data obtained from market research results collected in 2009 by the AC Nielsen Company of Canada was factored into the assessment. If more than one brand of a certain type of food was sampled, the proportion of each brand's share of the market (based on volume of sales) was used to determine the probability of a random selection of an acrylamide concentration from that particular brand and type of food. For example, if cookies of brand X represent 25 percent of the market share for all cookies, the selection of a random acrylamide level in cookies would be taken from the results found in brand X 25 percent of the time. Market share data was only used to estimate exposure when the Health Canada acrylamide occurrence data for a particular food was available for brands that collectively represent the majority of the market. This was the case for chocolate chip cookies, chocolate cream cookies, ginger cookies, prune juice, instant coffee, frozen French fries, arrowroot cookies, peanut butter, corn chips, and potato chips.

For each respondent in the CCHS survey, the estimated exposure to acrylamide from each food was summed to give an estimate of the total dietary acrylamide intake. The result is a distribution of total dietary exposure to acrylamide within a population. Five-hundred different exposure scenarios were generated for each individual (five-hundred iterations of the randomized assignment of acrylamide levels), from which mean and 90th percentile exposure estimates were calculated. The median value of the mean exposure estimates and the median value of the 90th percentile exposure estimates calculated for all individuals within a certain age group are reported in [Table 1](#).

Table 1 – Probabilistic dietary exposure estimates for acrylamide for select age-gender groups.

Age group (yrs)*	N	Acrylamide exposure (µg/kg bw per day)	
		Mean	90 th percentile
< 1	279	0.211	0.591
1 to 3	2096	0.609	1.516
4 to 8	3047	0.597	1.389
9 to 13	3883	0.442	1.043
14 to 18	4423	0.356	0.910
19 to 30	3713	0.288	0.740
31 to 50	5125	0.248	0.544
51 to 70	5533	0.187	0.367
≥ 71	3989	0.157	0.307

*Males and females are both included in each age group

N - number of respondents in that age category in the CCHS survey

µg/kg bw per day - microgram per kilogram of body weight per day

Results of the probabilistic exposure assessment show that children (from 1 to 8 years of age) ingest higher amounts of acrylamide through the diet, on a body weight basis, than other age groups. Mean acrylamide intakes range from 0.356 to 0.609 µg/kg bw per day for age groups from 1 to 18 years and from 0.157 to 0.288 µg/kg bw per day for adults (19 to 71+ years). Mean adult exposure estimates calculated by probabilistic methods are slightly lower than the results from Health Canada's preliminary exposure assessment. Exposure among infants < 1 year of age was lower than that of children and within the range of adult exposures.

Contribution of Different Foods to Acrylamide Exposure

Foods contributing most to the average total dietary acrylamide exposure for the general population above the age of 1 year are provided in [Table 2](#). The results shown here are similar to those found in the preliminary deterministic exposure assessment which utilized data collected prior to the launch of the acrylamide monitoring program.

Oven-baked French fries prepared from frozen products purchased at retail were found to contribute very little to acrylamide intake, accounting for approximately 1 percent of the overall dietary exposure for the total population. This is significantly lower than the contribution from restaurant French fries, generally prepared by deep frying, primarily due to the lower frequency of consumption of oven-baked French fries prepared at home from frozen products as reported by CCHS participants. Lower acrylamide levels in oven-baked frozen French fries prepared at home and the weight applied from market share data were also contributing factors.

Table 2 – Top contributors to average total dietary acrylamide exposure

Commodity	Contribution to dietary exposure (%)	Cumulative share (%)
Restaurant French fries	30.0	30.0
Snack chips (potato, corn)	14.9	44.9
Coffee (ready-to-drink)	12.3	57.2
Bread, toasted	6.4	63.6
Cereals	5.3	68.9
Bread, untoasted	4.0	72.9
Cookies	3.2	76.1
Popcorn	2.6	78.7
Crackers	2.5	81.2

Risk Characterization

In February 2010, the Joint Food and Agriculture Organization/World Health Organization Expert Committee on Food Additives (JECFA) reviewed the dietary exposure and toxicological data for acrylamide (JECFA, 2010). JECFA calculated Margins Of Exposure (MOE) using: (1) a No Observed Adverse Effect Level (NOAEL) of 200 µg/kg of body weight per day based on morphological changes in nerves in rats;

(2) a Benchmark Dose Lower Confidence Limit (BMDL) associated with a 10% response (BMDL₁₀) rate for mammary tumours in rats of 310 µg/kg bw per day; and (3) a BMDL₁₀ rate for Harderian gland tumours in male mice of 180 µg/kg bw per day.

MOE values were calculated by comparing the NOAEL and BMDL₁₀ values to the dietary exposure estimate for acrylamide according to the following equation:

$$\text{MOE} = \frac{\text{NOAEL (200 µg/kg bw per day) or BMDL}_{10} \text{ (310 and 180 µg/kg bw per day)}}{\text{Exposure estimate (µg/kg bw per day)}}$$

In general, the larger the MOE value, the lower the safety concern. However, the interpretation of MOE values in the context of an associated potential risk to human health is based on considerations of the chemical in question, the nature of the hazard it poses, any scientific uncertainties, and the expert judgment of the risk assessors.

The JECFA assessment estimated a mean dietary exposure to acrylamide of 1 µg/kg bw per day for the general population and a high exposure level of 4 µg/kg bw per day using a single point estimate approach. MOE values for mean and high exposure consumers using the most sensitive non-carcinogenic end-point (a NOAEL) were 200 and 50, respectively. MOEs using the lower BMDL₁₀ value for induction of tumours in mice were 180 for mean acrylamide exposures and 45 for high-end exposures. JECFA concluded that for a compound that is both genotoxic and carcinogenic, these MOEs for acrylamide indicate a human health concern.

The MOEs calculated in this assessment for various age groups using the mean and 90th percentile dietary exposure estimates, the NOAEL and the lowest BMDL₁₀ value considered by JECFA, are provided in [Table 3](#).

Table 3 – Margins of exposure (MOE) between dietary exposure to acrylamide and a NOAEL of 200 µg/kg bw per day and a BMDL₁₀ of 180 µg/kg bw per day.

Age group (yrs)*	MOE using NOAEL of 200 µg/kg bw per day		MOE using BMDL ₁₀ of 180 µg/kg bw per day	
	Mean	p90	Mean	p90
< 1	947	338	853	305
1 to 3	328	132	296	119
4 to 8	335	144	302	130
9 to 13	452	192	407	173
14 to 18	562	220	506	198
19 to 30	694	270	625	243
31 to 50	806	368	726	331
51 to 70	1070	545	963	490
≥ 71	1274	651	1146	586

*Males and females are both included in each age group

NOAEL - No Observed Adverse Effect Level

BMDL₁₀ - Benchmark Dose Lower Confidence Limit associated with a 10% response rate for Harderian gland tumours in male mice

p90 - 90th percentile

MOE values from mean and high-end exposure to acrylamide were lowest among young children (from 1 to 8 years of age), and highest for the adult age groups (above 19 years) and infants under 1 year. Overall, dietary exposure to acrylamide in Canada is estimated to be lower than that reported by JECFA which results in MOEs that are higher than those estimated by JECFA. Nonetheless, Health Canada concurs with the opinion of JECFA that dietary exposure to acrylamide represents a potential human health concern.

Uncertainties

Exposure estimates were derived based on the potential ingestion of foods that were included in phases 1 and 2 of the survey. Surveys conducted by other countries have found very low levels of acrylamide in some foods that were not included in this assessment, such as seafood and dairy products. Although the available data indicates that these foods would not significantly contribute to the total dietary exposure to acrylamide,

exposure may have been underestimated in this assessment as not all foods that may contain acrylamide were included. Health Canada will continue to update its estimate of the occurrence of acrylamide in a wide range of foods consumed by Canadians along with the corresponding exposure estimates.

Next Steps

Health Canada recently met with members of the food industry and other stakeholders to provide an update of its assessment on acrylamide in food. Health Canada continues to encourage the food industry to further pursue reduction efforts for acrylamide in processed foods. Acrylamide reduction strategies are available through the [Codex Alimentarius Code of Practice for the Reduction of Acrylamide in Foods](#) (CAC/RCP 67-2009) and the [Food Drink Europe Acrylamide Toolbox 2011](#). Health Canada is aware that certain segments of the Canadian food industry have implemented measures to reduce acrylamide in their products and continue to conduct research on new methods to further minimize acrylamide occurrence.

On March 14, 2012 Health Canada amended the [Food and Drug Regulations](#) to permit the use of asparaginase in certain food products. Asparaginase is an enzyme that will reduce the amount of the amino acid asparagine, which is naturally present in certain foods. Under specific cooking conditions and for certain foods, asparagine can react with other natural components of the food and form acrylamide. Reducing the amount of asparagine in these foods will reduce the amount of acrylamide formed during cooking.

Health Canada also continues to work with health authorities in other countries to better understand how acrylamide is formed in various foods, what foods contain the highest amounts of acrylamide, and what impact acrylamide has on human health. Health Canada plans to continue to collect information on the levels of acrylamide in foods that have not been sampled to date by Health Canada and/or in foods that potentially contain elevated levels of acrylamide. Future data collection endeavors will also serve to determine potential trends in acrylamide occurrence in order to assess the impact of the food industry's efforts in applying reduction strategies.

Health Canada also recommends practicing some simple [techniques to minimize acrylamide](#) formation in foods prepared at home and to consume a variety of foods according to [Eating Well with Canada's Food Guide](#).

References

Joint FAO/WHO Expert Committee on Food Additives (JECFA) 2010. [Summary and conclusions, seventy-second meeting, Rome, 16–25 February 2010](#).

Statistics Canada 2004. [Canadian Community Health Survey – Cycle 2.2 Nutrition \(CCHS\)](#). Detailed information for 2004 (Cycle 2.2), Ottawa (ON): Statistics Canada.

Appendix 1 - Concentrations of acrylamide in food products, on an as-consumed basis, available in Canada (µg/kg of food or parts per billion (ppb))

This table is considered a snapshot of a small proportion of the products that are available on the Canadian market and do not represent all brands and product types. No particular inference should be drawn from the presence or absence of any brand from this survey. The absence of a particular brand simply means that it was not sampled and does not mean that it would have either similar or dissimilar levels of acrylamide as those in brands of the same food listed below. Differences in acrylamide levels between foods and brands do not necessarily reflect differences in exposure or potential risk that would be faced by consumers, and should not be used as indices of healthy product choices.

Table of concentrations of acrylamide in food products, on an as-consumed basis, available in Canada (µg/kg of food or parts per billion (ppb))

Food commodity (Product description)	Brand name	n	Acrylamide (µg/kg of food)	
			mean	range
Baby food products				
Rice baby cereal	Beech Nut	1	< 10	--
Oatmeal baby cereal	Heinz	1	18	--
Multigrain baby cereal with fruit	Heinz	1	< 10	--
Mixed baby cereal	Milupa	1	< 10	--
Rice & banana infant cereal	Nestle	1	20	--
Soya cereal with pear	Heinz	1	< 10	--
Apple prune juice blend	Beech Nut	9	58	55-61
Apple prune drink from concentrate	Heinz	3	39	33-42
Strained/puree prunes	Gerber	6	259	253-265
Prune baby food	Heinz	4	108	102-118
Prune baby food	Parent's Choice – Walmart brand	4	157	120-194
Strained/puree prunes	President's Choice – Loblaw's brand	6	78	75-81
Strained/puree sweet potatoes	Gerber	8	79	74-86
Beginner sweet potatoes	Heinz	4	36	32-42
Strained/puree sweet potatoes	President's Choice – Loblaw's brand	7	61	56-69
Sweet potatoes baby food	Parent's Choice – Walmart brand	4	40	33-44
Vanilla custard pudding	Gerber	4	< 10	< 10

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Food commodity (Product description)	Brand name	n	Acrylamide ($\mu\text{g}/\text{kg}$ of food)	
			mean	range
Thickened A+ powder infant formula	Enfamil	1	< 10	--
Nurture Stage 2 powder infant formula	Heinz	1	< 10	--
Go & Grow powder infant formula	Similac	1	< 10	--
Bakery products				
Deep'n Delicious Double Chocolate Cake	McCain	4	14	< 10-17
In-house chocolate fudge cake	Loblaw	4	<10	< 10
Chocolate celebration cake	M&M Meat Shops	4	41	38-43
Pumpkin pie	M&M Meat Shops	4	< 10	< 10-14
Apple pie with cinnamon	Farmer's Market	4	22	18-27
Apple pie	Apple Valley Foods	2	25	21-28
Plain donuts	Tim Hortons	5	23	18-30
Plain donut holes	Tim Hortons	4	41	35-48
Plain donuts	Selection – Metro brand	2	16	15-16
Sour cream glazed donuts	Selection – Metro brand	2	< 10	< 10
Plain donuts	Country Style	2	13	11-15
Sour cream glazed donut holes	Country Style	2	14	13-15
Beverages				
Coffee, restaurant	McDonald's	6	< 10	< 10-11
Coffee, restaurant	Second Cup	4	< 10	< 10
Coffee, restaurant	Starbucks	6	12	< 10-15
Coffee, restaurant	Tim Hortons	6	12	11-14
Classic roast ground coffee	Folgers	4	< 10	< 10
Maxwell House Original roast ground coffee	Kraft	4	< 10	< 10
Nescafe rich instant coffee	Nestle	1	< 10	--
Maxwell House Original roast instant coffee	Kraft	2	< 10	< 10
Instant coffee	No Name – Loblaw's brand	1	< 10	--
Taster's Choice instant coffee	Nestle	1	< 10	--

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Food commodity (Product description)	Brand name	n	Acrylamide (µg/kg of food)	
			mean	range
Mellow blend instant coffee	Selection	1	< 10	--
Grain beverage with chicory	Caf-Lib	1	< 10	--
Prune nectar	Black River	2	68	67-68
Prune nectar	Great Value – Walmart brand	4	151	140-163
Prune nectar	Irresistibles – Metro brand	2	133	131-135
Unsweetened prune nectar	No Name – Loblaw's brand	7	216	186-247
R.W. Knudsen organic prune nectar	Smucker	4	688	478-916
Health Vision 100% Natural prune nectar	Vergers Paul Jodoin	4	86	85-87
Prune nectar	Welch's	8	295	237-423
Bread				
Whole wheat bagels	Weston	1	16	--
Swiss muesli bagel	Stonemill Bakehouse	1	11	--
Plain bagels	Weston	1	14	--
Plain bagels	Dempster's	1	10	--
Plain bagel – light toasting	Weston	2	28	27-29
Plain bagel – medium toasting	Weston	2	44	42-45
Plain bagel – dark toasting	Weston	2	88	84-91
Plain bagel – light toasting	Dempster's	1	34	--
Plain bagel – medium toasting	Dempster's	1	43	--
Plain bagel – dark toasting	Dempster's	1	100	--
Enriched white bread	Weston	1	18	--
Enriched white bread – light toasting	Weston	2	20	19-21
Enriched white bread – medium toasting	Weston	2	38	34-41
Enriched white bread – dark toasting	Weston	2	83	78-88
Enriched white bread	Dempster's	1	20	--
Enriched white bread – light toasting	Dempster's	1	25	--
Enriched white bread – medium toasting	Dempster's	1	85	--
Enriched white bread – dark toasting	Dempster's	1	134	--

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Food commodity (Product description)	Brand name	n	Acrylamide (µg/kg of food)	
			mean	range
White and whole wheat baguette	ACE Bakeries	3	< 10	--
Whole grain, 7 grain bread	Weston	1	39	--
Whole grain, 7 grain bread – light toasting	Weston	2	38	37-38
Whole grain, 7 grain bread – medium toasting	Weston	2	58	55-61
Whole grain, 7 grain bread – dark toasting	Weston	2	185	171-199
12 grain rye bread	Stonemill Bakehouse	1	20	--
11 whole grains and honey bread	Stonemill Bakehouse	1	23	--
Whole grain flax bread	Loblaw	1	79	--
Multigrain bread	Dempster's	1	46	--
Multigrain bread – light toasting	Dempster's	1	68	--
Multigrain bread – medium toasting	Dempster's	1	92	--
Multigrain bread – dark toasting	Dempster's	1	145	--
Whole wheat bread	Weston	2	44	39-48
Whole wheat bread – light toasting	Weston	2	79	76-82
Whole wheat bread – medium toasting	Weston	2	112	101-122
Whole wheat bread – dark toasting	Weston	2	162	161-162
Whole wheat bread	Dempster's	1	16	--
Whole wheat bread – light toasting	Dempster's	1	23	--
Whole wheat bread – medium toasting	Dempster's	1	30	--
Whole wheat bread – dark toasting	Dempster's	1	48	--
Sun-Maid raisin cinnamon bread	Canada Bread Company/Maple Leaf	1	< 10	--
Whole rye bread	Kasseler Food Products	1	23	--
100% whole wheat pita bread (sandwich pockets)	Handi Foods Ltd.	1	33	--
Organic whole wheat pita bread	Ozery's Pita Bread Inc.	1	< 10	--
Lavash flatbread	Ozery's Pita Bread Inc.	1	25	--
Tandoori pita bread	N/A (bulk)	1	69	--
Whole wheat tortillas	Weston	1	< 10	--

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Food commodity (Product description)	Brand name	n	Acrylamide (µg/kg of food)	
			mean	range
Whole grain, whole wheat tortillas	President's Choice – Loblaw's brand	1	< 10	--
Cheese buns	N/A (bulk)	1	17	--
Multigrain flax loaf	Loblaw	1	46	--
Sovital bread	Loblaw	1	15	--
Light rye crisp bread	Ryvita	9	649	160-1030
Light rye crisp bread	Wasa	4	276	178-360
Melba toast	Grissol	8	74	50-94
Cereals				
Honey nut Cheerios	General Mills	4	79	50-103
Oatmeal Crisp cereal	General Mills	5	336	178-407
Whole grain Cheerios	General Mills	2	152	152
Corn flakes	Kellogg's	2	58	39-77
Froot Loops	Kellogg's	2	26	--
Frosted flakes	Kellogg's	4	42	36-54
Mini-Wheats cereal	Kellogg's	4	106	72-144
Rice Krispies cereal	Kellogg's	5	58	35-92
Special K original cereal	Kellogg's	4	229	197-260
Two Scoops raisin bran cereal	Kellogg's	2	77	64-90
Life cereal	Pepsi-QTG	2	68	63-73
Honeycomb cereal	Post Foods	2	73	65-81
Shreddies cereal	Post Foods	5	107	70-128
Strawberry apple puffs	President's Choice – Loblaw's brand	1	26	--
Whole grain apple cinnamon puffs	Gerber	1	107	--
Mini apple cinnamon cereal bars	Heinz	2	55	51-58
Organic rice snacks	Heinz	1	212	--
Confectionery				
Premium dark chocolate	Cadbury	4	82	73-95
Butterscotch chipits	Hershey	4	< 10	< 10

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Food commodity (Product description)	Brand name	n	Acrylamide ($\mu\text{g}/\text{kg}$ of food)	
			mean	range
Creamy milk chocolate	Hershey	4	37	29-50
Swiss dark chocolate	Irresistibles – Metro brand	4	78	65-91
Baker's unsweetened chocolate	Kraft	4	391	387-400
Dark chocolate with almonds	President's Choice – Loblaw's brand	4	570	513-650
Jersey Milk chocolate	Neilson	4	21	19-25
Toll House dark chocolate baking bar	Nestle	4	105	84-125
Premium cocoa (powder)	Fry's	8	455	370-562
Premium cocoa (powder)	No name – Loblaw's brand	6	310	234-395
Cocoa powder (powder)	Selection – Metro brand	9	555	516-578
Sesame snaps	Sezme Brand	1	96	--
Cookies and biscuits				
Baby Mum-Mum original cookies	Want Want Foods Ltd.	9	52	34-72
Farley's biscuits	Heinz	6	46	37-63
Farley's instant cereal in biscuit form	Heinz	3	33	31-37
Let's Grow biter biscuits	Beech Nut	8	1401	1030-1900
Toddler instant cereal in biscuit form	Heinz	3	46	43-52
Toddler biscuits	Heinz	6	131	119-139
Let's Grow Arrowroot cookies	Beech Nut	6	126	101-144
Arrowroot cookies	Compliments – Sobeys' brand	4	198	131-268
Arrowroot cookies	President's Choice – Loblaw's brand	4	110	91-136
Mr. Christie Arrowroot cookies	Kraft	6	207	172-256
Honey Maid graham wafers	Kraft	9	261	224-299
Honey graham wafers	Compliments – Sobeys' brand	4	88	62-117
Original Gluco biscuits	Parle Products	1	1100	--
Crispy Jeera Cumin cookies	TWI Foods	1	78	--
Sesame fried cookies	Nice Choice	1	116	--
Peak Freans digestive cookies	Kraft	8	325	262-371
Teddy Grahams honey cookies	Kraft	6	134	104-158

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Food commodity (Product description)	Brand name	n	Acrylamide ($\mu\text{g}/\text{kg}$ of food)	
			mean	range
Breaktime ginger cookies	Dare	4	282	261-314
Ginger kids cookies	Voortman	4	290	184-390
Ginger snaps	Purity	4	578	438-665
Dad's Oatmeal Classic cookies	Kraft	9	243	222-277
Bear Claws soft cookies	Dare	3	42	41-44
Bear Paws chocolate chip cookies	Dare	6	52	44-58
Fudgee.O Original cookies	Kraft	8	80	70-95
Chunks Ahoy chocolate chip cookies	Kraft	9	218	161-309
Mr. Christie Oreo cookies	Kraft	9	23	12-33
Crackers				
Biscuit/cracker	Takara	1	285	--
Goldfish crackers	Pepperidge Farm	9	159	63-241
Premium Plus salted tops crackers	Kraft	8	35	27-50
Premium Plus unsalted tops crackers	Kraft	8	38	32-54
Premium Plus whole-wheat crackers	Kraft	3	13	10-19
Stoned Wheat Thins crackers	Kraft	9	25	13-47
Wheat pastry	OEC	1	267	--
Ritz Original crackers	Kraft	6	408	312-511
Plain crackers	Meiji	1	65	--
French fries				
French fries, restaurant	Burger King	6	360	276-601
French fries, restaurant	McDonald's	9	580	306-1120
French fries, restaurant	Wendy's	9	459	255-888
Potato wedges from frozen	Cavendish	4	766	706-849
Shoestring French fries from frozen	Cavendish	8	169	74-272
Coated spicy French fries from frozen	Cavendish	3	271	222-334
Crinkle cut French fries from frozen	Great Value – Walmart brand	4	198	96-306
Shoestring French fries from frozen	Great Value – Walmart brand	4	106	78-121

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Food commodity (Product description)	Brand name	n	Acrylamide (µg/kg of food)	
			mean	range
Straight cut French fries from frozen	No name – Loblaw's brand	4	533	413-667
Shoestring French fries from frozen	No name – Loblaw's brand	4	627	489-739
Straight cut French fries from frozen	McCain	8	113	48-280
Crinkle cut French fries from frozen	McCain	4	60	34-102
Shoestring French fries from frozen	McCain	2	41	36-46
Shoestring coated French fries from frozen	McCain	4	48	20-62
Fruits, vegetables and nuts				
Dried pears	N/A (bulk)	1	< 10	--
Dried plums	Yong Xing	1	< 10	--
Preserved plums	N/A (bulk)	1	< 10	--
Organic pitted prunes	Sunridge Farms	1	58	--
Pitted prunes	N/A (bulk)	2	87	73-101
Prunes without pits	N/A (bulk)	1	332	--
Smoked plum soup	King Kung	1	53	--
International Kalamata olives	Ziggy's – Loblaw's brand	3	< 10	< 10
Greek Kalamata olives	Sardo	3	< 10	< 10
Super colossal pitted ripe olives	Unico	9	60	50-67
Pitted black olives	Pastene	4	470	260-668
Medium pitted ripe black olives	Sardo	4	261	238-319
Medium pitted ripe black olives	Unico	4	494	345-622
Smooth peanut butter	Kraft	4	122	119-125
Smooth peanut butter	Selection – Metro brand	4	99	60-133
Smooth peanut butter	Skippy (Unilever)	4	85	75-95
Crunchy peanut butter	N/A (bulk)	2	99	98-99
Salted almonds	Planters	6	657	597-704
Roasted almonds with sea salt	Trophy	9	622	542-749
Roasted cashews	Compliments – Sobeys' brand	4	39	28-48
Salted cashews	Planters	7	23	17-30

Health Canada's Revised Exposure Assessment of Acrylamide in Food

Food commodity (Product description)	Brand name	n	Acrylamide ($\mu\text{g}/\text{kg}$ of food)	
			mean	range
Roasted and salted peanuts	Great Value – Walmart brand	4	31	30-32
Cocktail peanuts	Planters	10	32	24-41
Meat products				
Chicken nuggets, restaurant	Kentucky Fried Chicken	4	36	30-40
Chicken nuggets, restaurant	McDonald's	4	37	30-43
Chicken nuggets, restaurant	Wendy's	4	27	21-34
Chicken breast nuggets pub style from frozen	Janes	2	32	31-32
Chicken breast pub strips from frozen	Janes	2	38	37-38
Chicken nuggets from frozen	No name – Loblaw's brand	1	36	--
Chicken nuggets from frozen	President's Choice – Loblaw's brand	4	41	38-45
Pizza				
Pizza, restaurant	Pizza Hut	4	13	< 10-15
Pizza, restaurant	Pizza Pizza	4	30	14-42
Delissio thin and crispy crust pizza from frozen	Kraft	2	18	16-20
Pepperoni pizza from frozen	No name – Loblaw's brand	2	15	14-16
Traditional crust pepperoni pizza from frozen	McCain	2	< 10	< 10
Snack foods				
Crispy cake rusk	TWI Foods	1	75	--
Smartfood white cheddar popcorn	Frito Lay	4	151	145-159
Original popcorn	Neal Brothers	3	274	248-303
White cheddar popcorn	Neal Brothers	2	223	200-205
Popcorn	Papa Jack	4	234	205-268
Curry flavoured shrimp chips	Brilliant	1	< 10	--
Grill-A-Corn garlic toast flavoured chips	Calbee	1	324	--
Doritos nacho cheese corn chips	Frito Lay	9	287	251-308
Tostitos restaurant style corn chips	Frito Lay	9	459	429-495
Sun Chips, multigrain	Frito Lay	7	153	109-213
Restaurant style tortilla chips	Great Value – Walmart brand	6	48	34-64

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Food commodity (Product description)	Brand name	n	Acrylamide ($\mu\text{g}/\text{kg}$ of food)	
			mean	range
Restaurant style tortilla chips	President's Choice – Loblaw's brand	9	192	67-357
Honey BBQ chicken wing potato chips	Calbee	1	808	--
Regular potato chips	Compliments – Sobeys' brand	6	632	566-687
Sweet potato, cinnamon and brown sugar chips	Covered Bridge	4	1893	1419-2924
Lay's Baked Original potato chips	Frito Lay	6	225	187-274
Lay's Classic potato chips	Frito Lay	12	309	61-601
Ruffles potato chips	Frito Lay	9	293	179-376
Kettle cooked original potato chips	Irresistibles – Metro brand	4	801	477-1105
Kettle potato chips	Kettle	3	3203	2490-4660
Kettle salted potato chips	Kettle	6	364	278-434
Old Fashioned sea salt potato chips	President's Choice – Loblaw's brand	6	485	364-617
Ripple cut potato chips	No Name – Loblaw's brand	3	328	323-335
Miss Vickie's Original Recipe potato chips	Miss Vickie's	8	470	404-559
Pringles potato chips	Pringles	9	322	234-459
Baked Original potato chips	Selection – Metro brand	6	232	149-319
Sweet potato chips	Terra	4	1833	1560-2100
Regular potato chips	No Name – Loblaw's brand	3	659	617-680
Rold Gold classic style tiny twists pretzels	Frito Lay	9	160	131-193
Multigrain alphabet pretzels	President's Choice – Loblaw's brand	9	150	115-210
Salted, not roasted sunflower kernels	Stock & Barrel	1	16	--
Roasted salted sunflower seeds	N/A (bulk)	1	23	--
Moong Dal	Bikanervala Foods	1	38	--
Bikaneri Bhujia	Bikanervala Foods	1	54	--
Papri mixture	Bikanervala Foods	1	71	--
Kurkure masala munch	Pepsico Frito Lay	1	67	--
Spicy chick pea puffs	Surati Sweet Mart	1	41	--
Sooji gol gappa pani puri phuchka	Mampster	1	208	--

< 10 denotes below the limit of detection of 10 $\mu\text{g}/\text{kg}$