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Survey of Bisphenol A in Bottled Water Products

Bureau of Chemical Safety
Food Directorate
Health Products and Food Branch

A WHO Collaborating Centre for Food Contamination Monitoring

World Health Organization

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Canada

Health Canada is the federal department responsible for helping the people of Canada maintain and improve their health. *We assess the safety of drugs and many consumer products, help improve the safety of food, and provide information to Canadians to help them make healthy decisions. We provide health services to First Nations people and to Inuit communities. We work with the provinces to ensure our health care system serves the needs of Canadians.*

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Background

Bisphenol A (BPA) is the common name for 2,2-(4,4'-dihydroxydiphenyl)propane, 4,4'-isopropylidenediphenol, or 2,2'-bis(4-hydroxyphenyl)propane. It is used as an intermediate in the production of polycarbonate plastics and epoxy resins. Polycarbonate is used in food storage containers such as baby bottles, water bottles and water carboys; epoxy resins are used in the internal coating for food and beverage cans to protect the food from direct contact with the metal. BPA can migrate from polycarbonate plastic containers and cans with epoxy coating into foods, especially at elevated temperatures (for example, for hot-fill or heat-processed canned foods). BPA is one of the 23000 chemical substances on the CEPA (Canadian Environmental Protection Act) Domestic Substance List (DSL) identified for further evaluation under the Government of Canada's chemical management plan (CMP).

BPA was included in Batch 2 of the Challenge under CMP carried out by Health Canada and Environment Canada. On October 18, 2008, the Government of Canada released its final assessment report, including the Government's proposed risk management approaches to reduce Canadian exposure to BPA. Health Canada has committed to a research and monitoring agenda to further investigate potential human health effects of BPA and improve its understanding of Canadian exposure to this chemical through food sources. The purpose of this survey was to gather occurrence levels of BPA in bottled water products to contribute in updating the BPA exposure estimate for Canadians. The survey results were also published in the peer-reviewed scientific literature[1].

Sampling Plan and Analytical Methodology

In this survey, samples of 54 different bottled water products marketed under 21 brands by 16 companies were purchased in a local store in Ottawa in April 2008. These products covered a variety of water types, such as spring, mineral, flavoured, carbonated and non-carbonated. These products came in various types of containers including glass, metal, high density polyethylene (HDPE), polyethylene terephthalate (PETE) and polycarbonate. In addition, samples from two different brands of bottled water products in polycarbonate carboys in the office area (delivered directly by the producers) were also analysed for BPA. Containers of all polycarbonate bottled water products were the 18.5-L polycarbonate carboys.

[1] Cao, Xu-Liang and Corriveau, Jeannette (2008) 'Survey of bisphenol A in bottled water products in Canada', Food Additives and Contaminants: Part B, 1:2, 161 - 164.

The method based on isotope dilution headspace solid-phase microextraction followed by GC-MS analysis[2], developed previously by Health Canada, was used to analyse water samples for the presence of BPA in 56 bottled water products sold in Canada. The average method detection limit was 0.5 µg/L*. A total of 68 samples from the 56 bottled water products were collected, and two subsamples from each sample were analysed. The results shown in Table 1[3] are the average of the two analyses.

Notes:

- Bottled water samples were tested as consumed.
- It should be noted that the absence of any particular brand from this survey means only that the brand was not included in the survey. No particular inference should be drawn from the presence or absence of any brand.
- Samples represent a "snapshot" of the market at the time of sampling and do not represent market share. Product names and availability correspond to the time of sampling and may not represent current products on the market. Differences between brands do not necessarily reflect differences in consumer exposure to BPA.
- The results shown in Table 1[3] are generated for research purposes and should not be used to indicate the distribution of bisphenol A in bottled water products or as indices of good product choices for consumers.

BPA Levels in Bottled Water Products

Table 1[3] summarizes the levels of BPA determined in samples of the bottled water products. Levels of BPA in samples from all 51 non-polycarbonate bottled water products were less than the method detection limit of 0.5 µg/L*. BPA was detected in 13 of 17 samples from 4 of the 5 different polycarbonate bottled water products. Concentrations of BPA ranged from 0.50 to 8.82 µg/L*, with an average of 1.5 µg/L*. Since migration of BPA from polycarbonate containers into water at room temperature is very slow, it is likely that the products with higher BPA levels were exposed to heat (e.g. under the sun) during storage, and / or transportation.

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[2] Xu-Liang Cao and Jeannette Corriveau. Determination of Bisphenol A in Water by Isotope Dilution Headspace Solid-Phase Microextraction and Gas Chromatography/Mass Spectrometry Without Derivatization. J. AOAC Intern., 2008, 91, 622-629.

[3] The data contained in this document was published in peer-reviewed literature: Cao, Xu-Liang and Corriveau, Jeannette. Survey of Bisphenol A in Bottled Water Products in Canada, Food Additives and Contaminants*: Part B Vol*. 1, No. 2, December 2008, 161-164.

* 1 µg/L is equivalent to 0.000001 g/L or 1 part per billion (ppb)

Health Significance of the Survey Results

In March, 2008, Health Canada's Food Directorate completed a Health Risk Assessment of BPA from Food Packaging Applications[+] to determine exposure estimates to BPA. Health Canada's Food Directorate has concluded that:

- The current dietary exposure to BPA through food packaging is not expected to pose a health risk to the general population, including newborns and young children.
- In view of uncertainties related to datasets on possible neurodevelopmental and behavioural effects that BPA may have in experimental animals, Health Canada's Food Directorate has recommended that precaution be exerted on products consumed by the sensitive subset of the population, i.e. infants and newborns, by applying the ALARA (as low as reasonably achievable) principle to reduce their exposure to BPA through food packaging applications.

Other international food regulatory agencies – notably in the United States, Europe, the United Kingdom and Australia-New Zealand – have reviewed the Health Risk Assessment of Bisphenol A from Food Packaging Applications[+], prepared by Health Canada's Food Directorate, and have confirmed that the conclusions reached are supported by the current scientific evidence as described in the document.

The provisional tolerable daily intake (TDI) of 25 µg/kg body weight/day has been pre-established by Health Canada as a conservatively safe level for BPA presence in food and was confirmed in the 2008 Health Risk Assessment of BPA from Food Packaging Applications[+].

The contribution of BPA levels in bottled water to the overall exposure is negligible for the general population, and the consumption of water from polycarbonate carboys does not pose a safety concern.

Based on the average BPA level found in polycarbonate bottled water products (1.5 µg/L[*]), an adult (60 kg body weight) would have to consume approximately 1000 L of bottled water from polycarbonate carboys in one day to approach the TDI set by Health Canada's Food Directorate. For the specific population who consume water packaged only in polycarbonate carboys, the exposure to BPA would increase from 0.18 to 0.22 µg/kg body weight assuming an average of 1.5 µg/L* of BPA in polycarbonate bottled water and an average daily water consumption of 1.5 L.

[+] Health Risk Assessment of Bisphenol A from Food Packaging Applications. ISBN: 978-0-662-48686-2

[*] 1 µg/L is equivalent to 0.000001 g/L or 1 part per billion (ppb)

The results of this survey clearly indicate that exposure to BPA through the consumption of bottled water would be extremely low. The low levels of BPA found in polycarbonate bottled water products available for sale in Canada confirm Health Canada's previous assessment conclusion that the current dietary exposure to BPA through food packaging uses is not expected to pose a health risk to the general population.

Table 1: Concentrations (µg/L) of BPA in bottled water products as consumed

- It should be noted that the absence of any particular brand from this survey means only that the brand was not included in the survey. No particular inference should be drawn from the presence or absence of any brand.
- Samples represent a "snapshot" of the market and do not represent market share. Product names and availability correspond to the time of sampling and may not represent current products on the market. Differences between brands do not necessarily reflect differences in consumer exposure to BPA.
- The results shown in the table are exploratory and should not be used to indicate the distribution of bisphenol A in bottled water products or as indices of good product choices for consumers.

Container Type	Brand Name / Producer	Product Name	Country or Province of Origin	Container Size (L)	BPA Concentration (µg/L)
Can	Nestle Waters Canada	Perrier Carbonated Natural Spring Water	France	0.33	<MDL
Glass	Loblaws Inc.	President's Choice Splendido Lightly Carbonated Natural Mineral Water	Italy	0.75	<MDL
		President's Choice Carbonated Natural Spring Water	Italy	0.75	<MDL
		President's Choice Lime Flavoured Natural Spring Water	Italy	0.75	<MDL
	Nestle Waters Canada	S.Pellegrino Carbonated Natural Mineral Water	Italy	0.75	<MDL
		S.Pellegrino Carbonated Natural Mineral Water	Italy	0.25	<MDL
		Perrier Lime Carbonated Spring Water	France	0.75	<MDL
		Perrier Natural Spring Water	France	0.75	<MDL
		Perrier Lemon Carbonated Spring Water	France	0.75	<MDL
	Santa Maria Food Corp Toronto	San Benedetto Carbonated Natural Spring Water	Italy	0.75	<MDL
	Tree of Life, Mississauga	Apollinaris Classic Naturally Carbonated Mineral Water	Germany	1	<MDL
HDPE	Loblaws Inc.	Real Canadian Natural Spring Water	Ontario	4	<MDL
		President's Choice Natural Spring Water	Ontario	10	<MDL
Polycarbonate	Aquaterra Corporation	Labrador Source Natural Spring Water	Quebec	18.5	0.86
	Culligan of Brockville	Culligan Demineralized Water, Bottle 1	Canada	18.5	8.82
		Culligan Demineralized Water, Bottle 2	Canada	18.5	6.52
		Culligan Demineralized Water, Bottle 3	Canada	18.5	0.8
		Culligan Demineralized Water, Bottle 4	Canada	18.5	<MDL
		Culligan Demineralized Water, Bottle 5	Canada	18.5	0.79
		Culligan Demineralized Water, Bottle 6	Canada	18.5	1.09
		Culligan Demineralized Water, Bottle 7	Canada	18.5	0.5

Polycarbonate	Loblaws Inc.	President's Choice Natural Spring Water Non Carbonated	Quebec	18.5	0.67
		President's Choice Distilled Water	Canada	18.5	<MDL
	LPCS Carleton Place,ON	Water Life Purely for the Taste Natural Spring Water, Bottle 1	Ontario	18.5	0.98
		Water Life Purely for the Taste Natural Spring Water, Bottle 2	Ontario	18.5	<MDL
		Water Life Purely for the Taste Natural Spring Water, Bottle 3	Ontario	18.5	1.4
		Water Life Purely for the Taste Natural Spring Water, Bottle 4	Ontario	18.5	0.63
		Water Life Purely for the Taste Natural Spring Water, Bottle 5	Ontario	18.5	<MDL
		Water Life Purely for the Taste Natural Spring Water, Bottle 6	Ontario	18.5	0.64
		Water Life Purely for the Taste Natural Spring Water, Bottle 7	Ontario	18.5	0.59
PETE	Aquaterra Corporation	Canadian Springs Distilled Water	Quebec	4	<MDL
		Canadian Springs Natural Spring Water	Quebec	8	<MDL
	Coca-Cola Company	Dasani Remineralized Water	Ontario	1	<MDL
		Dasani Remineralized Water	Ontario	0.5	<MDL
		Dasani Natural Lemon Flavoured Water Beverage	Ontario	0.5	<MDL
	Danone Waters of Canada Inc.	Evian Natural Spring Water	France	1.5	<MDL
		Evian Natural Spring Water	France	0.33	<MDL
	DNW/EDN	Silhouette Danone Lemon Spring Water Based Beverage	Quebec	1	<MDL
		Silhouette Danone Pink Grapefruit Green Tea Spring Water Based Beverage	Quebec	1	<MDL
		Naya Aquakids Natural Spring Water	Quebec	0.33	<MDL
	Elco Fine Foods Inc.	Gerolsteiner Naturally Sparkling Mineral Water	Germany	1	<MDL
	Ice River Springs Water Co. Inc.	Ice River Springs Natural Spring Water	Ontario	0.5	<MDL
	Loblaws Inc.	Real Canadian Natural Spring Water	Ontario	1.5	<MDL
		President's Choice Free & Clear Golden Peach Sparkling Water Beverage	Ontario	1	<MDL
		President's Choice Free & Clear Tangerine Lime Sparkling Water Beverage	Ontario	1	<MDL
		President's Choice Free & Clear Berries of the Woods Sparkling Water Beverage	Ontario	1	<MDL

PETE	Loblaws Inc.	President's Choice Free & Clear Key Lime Sparkling Water Beverage	Ontario	1	<MDL
		President's Choice Free & Clear Blackcurrant Cassis Sparkling Water Beverage	Ontario	1	<MDL
		President's Choice Free & Clear Black Cherry Sparkling Water Beverage	Ontario	1	<MDL
		President's Choice Orange Mist Flavoured Water Beverage	Ontario	0.5	<MDL
		President's Choice Strawberry Mist Flavoured Water Beverage	Ontario	0.5	<MDL
		President's Choice Natural Spring Water	Ontario	1.5	<MDL
	Majestic North Group Inc.	Nateczowianka Natural Mineral Water	Poland	1.5	<MDL
	Metro Brands	Master Choice Carbonated Natural Spring Water	Quebec	1	<MDL
	Nestle Waters Canada	Montclair Natural Spring Water	Ontario	0.71	<MDL
		Pure Life Sparkling Original Carbonated Spring Water	Maine,USA	1	<MDL
		Pure Life Sparkling Lime Carbonated Spring Water	USA	1	<MDL
		Pure Life Natural Spring Water	Ontario	1.5	<MDL
		Perrier Carbonated Natural Mineral Water	France	0.5	<MDL
	Pepsico Inc.	Aquafina Citrus Blend Naturally Flavoured Water Beverage	Ontario	0.5	<MDL
	Pepsi-QTG Canada	Aquafina Raspberry Naturally Flavoured Water Beverage	Ontario	0.5	<MDL
		Aquafina Berry Burst Naturally Carbonated Water Beverage	Ontario	0.5	<MDL
		Propel Gatorade Vitamin Enhanced Water	Ontario	0.5	<MDL
	Pepsi-Cola Canada Ltd	Aquafina Demineralized Treated Water	Ontario	1.5	<MDL
	Santa Maria Food Corp Toronto	Naturale San Benedetto Mineral Water	Italy	0.5	<MDL
		Naturale San Benedetto Natural Spring Water	Italy	1.5	<MDL
		Frizzante San Benedetto Carbonated Natural Spring Water	Italy	1.5	<MDL
	S&F Food Importers Inc.	Jordanka Sparkling Natural Mineral Water	Poland	1.5	<MDL