Health Risk Assessment - Benzene in Beverages Sampled in 2007

A PAHO/WHO Collaborating Center for Food Contamination Monitoring
Health Risk Assessment - Benzene in Beverages Sampled in 2007

This health risk assessment was prepared as a follow-up to the Assessment released on May 19, 2006

Chemical Health Hazard Assessment Division
Bureau of Chemical Safety
Food Directorate
Health Canada
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Summary

During the course of 2007, Health Canada has conducted a survey on the presence of benzene in soft drinks and other beverages. This survey was a follow-up to the 2006 survey on benzene levels in beverages which was carried out in response to reports of elevated levels of benzene found in such products. These beverage surveys have allowed Health Canada to quantify the presence of benzene in soft drinks and other beverages, assess the potential risks associated with exposure to benzene through the consumption of beverages, and identify any risk management strategies that might be required.

The 2007 follow-up survey was performed in order to re-analyse those beverages found to contain a higher level of contamination in 2006 and to ensure that benzene levels have remained low during beverage manufacture. The results of the 2007 health risk assessment (described below) are consistent with those of the 2006 assessment, confirming that there is a negligible health risk posed by the consumption of soft drinks and other beverages which are available for sale in Canada. In order to ensure that the health risks for the Canadian consumer remains negligible, Health Canada and the Canadian Food Inspection Agency (CFIA) intend to continue to follow up with companies whose product samples are found to contain marginally elevated levels of benzene.

Benzoic acid is used as a preservative in some beverages and can react with ascorbic acid (whether added or naturally-occurring) to form benzene. Based on this knowledge, the Bureau of Chemical Safety in Health Canada’s Food Directorate has focussed on collecting products containing added benzoic acid or its salts. However, a few product samples were collected that do not contain benzoic acid but rather utilize aseptic packaging to maintain microbial stability. Of the 139 products sampled during the 2007 follow-up survey, 110 were the same products as those analysed in 2006. The remaining 29 additional products are either new to the market or were not available during the previous survey year. Collected samples consisted of both ready-to-consume and concentrated products which require further dilution before consuming.

It is important to note that the detection limit of the analytical method used in 2007 was reduced from 1 and 2 nanograms per millilitre (ng/mL) (two different methods were employed in 2006)
to a more sensitive detection limit of 0.016 ng/mL. This is due to methodological improvements made by scientists at Health Canada. Due to the increased sensitivity of the new method, the number of positive detections of benzene (67% of samples) has increased from the previous year. However, the low levels of benzene detected are not considered to pose a health risk.

In the 2007 survey, levels of benzene were found in three products, including two concentrated products, above the Canadian guideline of 5 ng/mL for benzene in drinking water: (1) all four sampled lots of MOTT's Mr. & Mrs. T Margarita Mix (a concentrated mix); (2) one lot of diet, sugar-free A&W Famous Root Beer (three other lots of this product were very low in benzene); and (3) one sampled lot of Chateau Thierry Brand Amaretto syrup (a concentrated product).

(1) The benzene levels in samples of Mr. & Mrs. T Margarita Mix products ranged from 11 to 18 ng/mL (average 15.75 ng/mL). These results were higher than those reported for this product in the 2006 survey (9.9 ng/mL for the product purchased from a retail location and 2.5 ng/mL for the producer-supplied sample). However, the manufacturer has subsequently reformulated the product, replacing sodium benzoate with potassium sorbate and sodium hexametaphosphate to prevent the formation of benzene. Samples of the reformulated product were analysed by Health Canada and confirmed to contain much reduced levels of benzene (average 0.041 ng/mL). The reformulated products are scheduled to be on store shelves by January 2008. The levels of benzene in the reformulated product are not considered to constitute a health risk.

(2) The average benzene level in one sample lot of A&W diet root beer was 9.1 ng/mL, leading to an average of 2.56 ng/mL for all 4 sample lots (range; 0.06 - 9.1 ng/mL). The benzene results across the 4 lots were not consistent and it was determined that lots 2 to 4 were produced after lot 1. It was therefore concluded that the elevated benzene level for lot 1 was not the result of in situ formation of benzene. The average of lots 2 to 4, excluding lot 1, was only 0.38 ng/mL. Based on the isolated elevated benzene results, long-term exposure to elevated levels is considered unlikely and the much lower benzene levels that were seen in the other three sampled lots would not constitute a health risk.

(3) With regards to the Chateau Thierry Brand Amaretto syrup, the level of benzene found in this undiluted product was slightly elevated compared to the 2006 sample (7.14 compared to 5.02 ng/mL). However, levels of benzene in this product "as consumed" (2.38 ng/mL) are considered low and would not constitute a health risk.

A complete description of the 2007 survey, including a table of results, is provided in A Follow-up Survey of Benzene in Soft Drinks and Other Beverage Products. The table of results, showing the conversion of concentration values to units appropriate for the risk assessment, may also be viewed in Appendix 1.

The Bureau of Chemical Safety in Health Canada's Food Directorate conducted a human health risk assessment based on the observed levels of benzene in soft drinks and other beverages, the potential exposure to benzene from consuming these products, and a comparison of the potential exposure to the doses associated with negative health effects from benzene. Health Canada considers the consumption of those products showing the most elevated levels of benzene, as
reported by the survey, over a short-term period to constitute a class 3 health risk; that is, they do not pose a health risk to the Canadian public. Also, the remaining products, which either contained very low levels of benzene or did not contain benzene at detectable levels, are not considered to pose a health risk.

**Background**

The Bureau of Chemical Safety (BCS) initiated a survey of benzene levels in beverages available on the Canadian retail market in 2006 as a result of reports of elevated levels of benzene in soft drinks in the United States, a small number of which exceeded the U.S. Environmental Protection Agency (U.S. EPA) maximum contaminant level of 5 ng/mL for benzene in drinking water. The BCS Food Research Division (FRD) analysed the samples and the results were assessed for possible risk to human health by the Bureau's Chemical Health Hazard Assessment Division (CHHAD). A follow-up survey was conducted in 2007, the assessment of which is described below.

**Hazard Characterization**

The hazard assessment for benzene dietary exposure originally conducted by Health Canada in 1991 and reviewed in 2006 remains unchanged. The current Tolerable Daily Intake (TDI) for benzene ingested from food and beverages (0.36 μg/kg bw/day) and the U.S. EPA-derived oral slope factors (cancer risk per unit dose) which are based on a human cancer endpoint (1.5x10⁻² to 5.5x10⁻² mg/kg/day⁻¹) continue to be employed when assessing the level of risk associated with the dietary ingestion of benzene. These reference values remain comparable to current international regulatory guidelines for the ingestion of benzene.

A quantitative environmental risk assessment conducted by Toxicology Excellence for Risk Assessment (TERA), which had not yet been completed during the Health Canada 2006 summer risk assessment, has since been made available. TERA employed the existing U.S. EPA-derived non-cancer RfD (4 μg/kg bw/day) and generated a range of alternative RfDs in their risk assessment. This range of alternative RfDs was based on the same Rothman *et al.* (1996) study that was used to derive the 4 μg/kg bw/day RfD, with the exception that less conservative uncertainty factors were applied in the RfD calculations. The reduction of uncertainty factors was due to the following determinations: the literature does not support child-specific sensitivity in the case of benzene, the Rothman *et al.* (1996) study exhibits no effect of duration of exposure, and the most sensitive endpoint was employed in the calculation. These determinations resulted in the generation of various non-cancer RfDs for general environmental exposure to benzene ranging from 10 - 100 μg/kg bw/day.

Furthermore, the same U.S. EPA-derived cancer slope factors currently referenced during Health Canada's assessments were also utilized in the TERA risk assessment. TERA concluded that the margin of safety (MOS) approach is appropriate for benzene risk assessments and that ranges of RfDs and cancer slope factors provide insight into risks from general environmental exposures to benzene.

For dietary exposure to benzene, the TDI established by Health Canada and the U.S. EPA-derived oral slope factors continue to be considered both appropriate, and comparable
internationally as reference values for assessing the health risks associated with benzene ingested from food and beverages.

Further details on the hazard characterization may be found in the May 19, 2006 Health Risk Assessment on Benzene in Beverages.

Exposure Assessment

Analytical results

The results of the analysis of 139 product samples from 150 lots are described in “A Follow-up Survey of Benzene in Soft Drinks and Other Beverage Products”. Samples included some of the same brands, as well as similar products to, those analysed in 2006. These included soft drinks, juices, low-alcohol coolers, concentrated syrups and cocktail mixes. Benzene concentrations were reported in nanograms per millilitre (ng/mL) and converted to nanograms per gram (ng/g) using the corresponding density values.

Of the 139 different products analysed, 46 were found to be below the analytical detection limit of 0.016 ng/mL, representing a 67% incidence of positive detections of benzene. This higher incidence is a reflection of methodological improvements resulting in a more sensitive detection limit than those of 2006 (the detection limits for each of two different methods used in 2006 was 1 and 2 ng/mL). This allows for the determination of benzene at lower levels.

Benzene concentrations ranged from 0.02 to 18 ng/mL in the 93 positive products. Three of these products contained benzene at levels above the Canadian guideline of 5 ng/mL benzene in drinking water.

A synopsis of the results is presented below:

- Reformulated Kool Aid products continued to contain reduced benzene levels. Kraft, the manufacturer of these products, is no longer utilizing benzoates (or sorbate) but has adopted the use of aseptic packaging to achieve microbial stability. As a result, benzene levels were very low in these products.

- There were two concentrated products containing more elevated benzene levels, both of which require dilution prior to consumption as a beverage; namely, Mr. & Mrs. T Margarita Mix and Chateau Thierry Brand Amaretto syrup. The average benzene level from four different lots of undiluted Mr. & Mrs. T Margarita Mix products was 15.75 ng/mL, with a range of 11-18 ng/mL. These results were higher than those reported for this product in the 2006 survey (9.9 ng/mL for the product purchased from a retail location and 2.5 ng/mL for the producer-supplied sample, provided at a later date). The manufacturer has since reformulated this product and analysis of commercial samples indicate that benzene levels are significantly reduced (average 0.041 ng/mL). The level of benzene found in the undiluted Amaretto syrup was slightly elevated compared to that of the 2006 sample (7.14 compared to 5.02 ng/mL).

- Density values were measured and provided by the Food Research Division in the Bureau
of Chemical Safety, Food Directorate, Health Canada.

- Reported levels of benzene in two of Rose's Cocktail infusion products (sour apple and cranberry twist mix) were lower than levels in the 2006 samples (4.65 and 5.97 ng/mL, respectively), and not detected for the producer-supplied sample of cranberry twist mix, compared to 0.38 and 0.09 ng/mL in 2007, respectively. Average levels in Rose's Cocktail Infusion - blue raspberry mix were similar to that reported in 2006, 1.75 ng/mL compared to 1.49 ng/mL.

- One sample lot of A&W Diet, sugar-free Famous Root Beer contained higher levels of benzene (9.10 ng/mL, based on an average of six samples analysed from that lot). The average for all 4 sampled lots (range; 0.06 - 9.1 ng/mL) was 2.56 ng/mL. An average of 0.38 ng/mL was determined for the remaining three lots, when the one high sample lot was excluded from the calculation.

- Average benzene concentrations ranged from 0.82 to 2.77 ng/mL in 6 sampled lots of Casal Domingo Light Wine Cooler Tropical splash, representing an overall decrease from the 2006 levels of 3.3 to 4.4 ng/mL. Similar decreases were apparent in other Casal Domingo Light Wine Cooler products.

- The remaining positive samples were found to contain less than 1.59 ng/mL of benzene.

While a broad range of products were sampled, both the number of samples of each product type and the number of lots sampled were limited. Also, sampled products were collected from a relatively small geographic area (all products were purchased in local grocery stores in Ottawa). As such, the results do not necessarily reflect variations that might be observed in the Canadian market in general.

Dilution factors were applied to concentrations of benzene found in concentrated products (that is, those requiring dilution prior to consumption), based on product label instructions, in order to obtain the benzene concentrations in these products “as consumed”.

Mean concentration values were used in the exposure assessment, in consideration of the chronic nature of the potential health effects of exposure to benzene. The mean 2007 values shown below in Table 1 are decreased relative to the mean 2006 values. This is a reflection of lowered concentration levels in some cases, but it is also a reflection of the improved analytical methodology. This lowered detection limit also affects the assumed concentration of non-detects (that is, samples in which benzene was too low to be detected). Non-detects were assumed to contain benzene at a concentration equal to half the detection limit.

Table 1: Summary statistics for the concentration of benzene in various beverages "as consumed". Non-detects were set to one-half the analytical detection limit. The raw data, in ng/mL, were converted to the units ng/g using the appropriate density values. As the concentrations in concentrates and mixes were corrected to obtain the concentration in the beverage "as consumed", some values reported below are lower than the actual analytical detection limit of 0.016 ng/mL (roughly equivalent to 0.016 ng/g).
<table>
<thead>
<tr>
<th>Sample</th>
<th>Benzene concentration (ng/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min</td>
</tr>
<tr>
<td>All non-alcohol beverages</td>
<td>0.001</td>
</tr>
<tr>
<td>Alcoholic beverages only (mainly coolers and cocktail mixes)</td>
<td>0.020</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free</td>
<td>0.061</td>
</tr>
<tr>
<td>Chateau Thierry Brand Amaretto Syrup</td>
<td>1.824</td>
</tr>
<tr>
<td>Mott's Mr. &amp; Mrs. T Margarita Mix - old formula</td>
<td>6.316</td>
</tr>
<tr>
<td>Mott’s Mr. &amp; Mrs. T Margarita Mix - reformulated</td>
<td>0.024</td>
</tr>
</tbody>
</table>

- 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.

- It should be noted that differences between foods and brands do not necessarily reflect differences in exposure or potential risk that would be faced by consumers. The results shown in the table are exploratory and should not be used as indices of good product choices for consumers.

**Consumption Figures**

Exposure calculations based on the 2007 results were carried out using data from the Canadian Community Health Survey - Cycle 2.2 on Nutrition, Statistics Canada, 2004. In all but one scenario, consumption was assumed to be daily. For the consumption of alcoholic beverages by 12 to 19 year olds, frequency of consumption was assumed to be two days of every seven.

For “alcoholic beverages”, Canadian Community Health Survey (CCHS) Eaters-Only mean consumption figures for males (a higher consuming group than females) were utilized. For “non-alcoholic beverages”, the following CCHS food categories were used: soft drinks, fruit drinks and fruit juices. Eaters-Only mean consumption figures for males (again, the higher consuming group) were employed for 12-19 year old teenagers and adults. In the case of 5 to 11 year old children, eaters-Only mean consumption figures for males and females combined were employed.

**Body weights**

The following mean body weights, derived from the Canadian Community Health Survey, were employed in the assessment: 70 kg for an adult; 60 kg for a 12 to 19 year old; and 30 kg for a 5 to 11 year old.

**Probable Daily Intake Values**

A deterministic exposure assessment was used to calculate “Probable Daily Intakes" (PDI) of benzene based on the mean concentration values for beverages as consumed. Calculations for
the following exposure scenarios are shown in Appendix 2:

- All non-alcoholic;
- Alcoholic beverages (low-alcohol coolers and cocktail mixes);
- Diet A&W Famous Root Beer, sugar-free (includes three scenarios);
- Chateau Thierry Brand Amaretto syrup; and
- Mott’s Mr. & Mrs. T Margarita Mix (for each of the old and new formulations).

A summary of the PDI values is shown below in Table 2.

Table 2: Probable daily intake (PDI) values of benzene from various beverage types, assuming daily intake of the beverages by “Eaters-Only” and using mean intake and mean concentration values.

<table>
<thead>
<tr>
<th>Beverage Type</th>
<th>PDI (ng/kg bw/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>adult</td>
</tr>
<tr>
<td>All non-alcohol beverages</td>
<td>1.8</td>
</tr>
<tr>
<td>Alcoholic beverages only</td>
<td>11</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free*</td>
<td>23.7</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free†</td>
<td>3.5</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free‡</td>
<td>84.3</td>
</tr>
<tr>
<td>Chateau Thierry Brand Amaretto syrup</td>
<td>19.6</td>
</tr>
<tr>
<td>Mott’s Mr. &amp; Mrs. T Margarita Mix - old formula</td>
<td>97</td>
</tr>
<tr>
<td>Mott’s Mr. &amp; Mrs. T Margarita Mix - reformulated</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>12-19 yr old</td>
</tr>
<tr>
<td>All non-alcohol beverages</td>
<td>2.8</td>
</tr>
<tr>
<td>Alcoholic beverages only</td>
<td>4.2</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free*</td>
<td>38.2</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free†</td>
<td>5.7</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free‡</td>
<td>135.8</td>
</tr>
<tr>
<td>Chateau Thierry Brand Amaretto syrup</td>
<td>7.6</td>
</tr>
<tr>
<td>Mott’s Mr. &amp; Mrs. T Margarita Mix - old formula</td>
<td>37.5</td>
</tr>
<tr>
<td>Mott’s Mr. &amp; Mrs. T Margarita Mix - reformulated</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>5-11 yr old</td>
</tr>
<tr>
<td>All non-alcohol beverages</td>
<td>3.3</td>
</tr>
<tr>
<td>Alcoholic beverages only</td>
<td>n/a</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free*</td>
<td>45.2</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free†</td>
<td>6.7</td>
</tr>
<tr>
<td>Diet A&amp;W Famous Root Beer, sugar-free‡</td>
<td>160.7</td>
</tr>
<tr>
<td>Chateau Thierry Brand Amaretto syrup</td>
<td>n/a</td>
</tr>
<tr>
<td>Mott’s Mr. &amp; Mrs. T Margarita Mix - old formula</td>
<td>n/a</td>
</tr>
<tr>
<td>Mott’s Mr. &amp; Mrs. T Margarita Mix - reformulated</td>
<td>n/a</td>
</tr>
</tbody>
</table>

* PDI value reported here is based on the average of all 4 sampled lots.
† PDI value reported here is based on the average of the three sampled lots that contained only low levels of benzene, with the one high lot excluded.
‡ PDI value reported here is based on the one sample lot with an elevated benzene concentration.

- 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.
- It should be noted that differences between foods and brands do not necessarily reflect differences in exposure or potential risk that would be faced by consumers. The results shown in the table are exploratory and should not be used as indices of good product choices for consumers.

Other Sources of Exposure to Benzene

A discussion of other sources of exposure to benzene is found in the May 19, 2006 Health Risk Assessment on Benzene in Beverages.
Risk Characterization

All beverages (non-alcoholic and alcoholic)

Benzene levels in beverages assessed in the 2007 survey, have, for the most part, remained low relative to those levels seen in 2006; therefore, exposure estimates, expressed as Probable Daily Intakes (PDI), have also remained low. All PDI values for children aged 5-11, teenagers 12-19 and adults for the 2007 data were lower than the various Tolerable Daily Intake (TDI) and Reference Dose (RfD) values that have been derived by various regulatory organizations.

With respect to the exposure scenarios that were based on the mean of occurrence values for all of the non-alcoholic beverages and on the mean concentration of the alcoholic beverages (low-alcohol coolers and cocktails), the highest PDI value was approximately 11.0 ng/kg bw/day for adult consumers of alcoholic beverages, which is below the TDI and RfD values and would be associated with an estimated cancer risk of $10^{-7}$ based on the U.S. EPA's oral slope factor. Therefore, consumption of these products in general would be of negligible concern to human health.

Diet A&W Famous Root Beer, sugar-free

One sampled lot of diet A&W Famous Root Beer, sugar-free, contained elevated levels of benzene, with an average concentration of 9.1 ng/mL. The PDI for the consumption of a beverage containing 9.1 ng/mL benzene (Table 2) for a consumer who has a strong preference for this product and may therefore consume it daily, was approximately 161 ng/kg bw/day for children aged 5 to 11 years of age. This PDI is lower than the Tolerable Daily Intake (TDI) and Reference dose (RfD) values that have been derived by various regulatory groups and would correspond to a lifetime cancer risk of $10^{-5}$ utilizing the U.S. EPA-derived oral slope factors. However, this PDI value is only representative of the highest mean (of six samples) concentration of one of the four sampled lots and is not considered to be representative of the product in general. If the potential exposure to benzene had been of this magnitude and had been projected to occur over an extended period of time, the exposure would have been considered of low concern to human health, constituting a class 2 health risk.

The remaining three lots contained much lower levels of benzene (0.06, 0.18 and 0.91 ng/mL respectively) which would correspond to an average PDI of 6.7 ng/kg bw /day. These three lots were manufactured after the first lot and it is therefore concluded that the one elevated lot would not have resulted from benzene in-situ formation. It is considered unlikely that an individual would be exposed to this elevated level of benzene on a long-term basis. Due to the other subsequently manufactured retail lots showing lower concentrations of benzene, any risk from benzene associated with the consumption of these products over the long-term should be considered of negligible concern to human health.

Mott’s Mr. & Mrs. T Margarita Mix

Elevated benzene levels were also encountered in four different lots of Mr. & Mrs. T Margarita Mix (a concentrated cocktail mix), ranging from 11-18 ng/mL, with an average concentration of
15.75 ng/mL over all sampled lots (corresponding to a concentration of 9.84 ng/mL or 9.04 ng/g benzene in the ready-to-consume beverage). These results were higher than those reported for this product in the 2006 survey (9.9 ng/mL for the concentrated mix purchased from a retail location and 2.5 ng/mL for the producer-supplied sample, which was subsequently provided). The PDI for consumers who may show a strong preference for this particular product, such that adults consume it on a daily basis or teenagers consume it twice per week, was 97 and 37.5 ng/kg bw/day for adult and 12 to 19 year olds, respectively. Again, these values are lower than the TDI and RfD values derived by various regulatory bodies. They are approximately one and a half times higher than the upper bound of the U.S. EPA-derived dose associated with a cancer risk of $10^{-6}$, and would therefore correspond to a lifetime cancer risk of $10^{-5}$ and be considered of low concern to human health. However, the potential exposure to benzene from this product over an extended period of time is no longer possible, due both to the reformulation of this product which has resulted in greatly reduced benzene levels (average 0.041 ng/mL), and due to the expected depletion of the old stock of this product by the end of January 2008. As such, the product is considered to be of no concern to human health.

*Amaretto Syrup*

The level of benzene found in the sampled lot of Amaretto syrup was elevated compared to the 2006 sample (7.14 compared to 5.02 ng/mL). However, the consumption of this product does not represent an unacceptable health risk, even to consumers with a strong preference for this product, such that they consume it on a daily basis, as both the density of this particular product and the way in which it is typically consumed (dilution of the product), leads to lower benzene levels in the product “as consumed”. It is therefore also considered that the benzene exposure from this product would not be of concern to human health.

*Total Dietary Exposure*

As noted in the 2006 assessment, it is difficult to place these PDI values in the context of total dietary exposure to benzene, given the range of dietary intakes reported in the literature. The highest intake of benzene from beverages that was calculated based on the 2006 survey was insignificant relative to the total dietary intake estimated by Health Canada’s Bureau of Chemical Safety in 1992; one-half the exposure estimated by Environment Canada and Health Canada in 1993; and four orders of magnitude lower than the total dietary intake estimated by the Netherlands (as cited by WHO) and by the U.S. NRC in 1980. In the current assessment, the vast majority of the PDI estimates are reduced when compared to the 2006 assessment, particularly the estimates for those considered to be in the most sensitive groups (i.e.: children). As such, the potential exposure to benzene from beverage consumption is considered to constitute a relatively small portion of overall lifetime dietary exposure to benzene.

*Risk Mitigation*

*Other Jurisdictions*

The Center for Food Safety and Applied Nutrition (CFSAN) of the United States Food and Drug Administration (FDA) conducted surveys of benzene levels in soft drinks and beverages on two
occasions, the first following reports generated by a private laboratory on the presence of low levels of benzene in soft drinks and the second as a follow-up. In the first survey of over 100 beverages, five products were found to contain benzene at levels above 5 ppb. In the second survey conducted between April 21, 2006 and May 16, 2007, 86 samples of beverages were analysed for the presence of benzene, of which five were again above 5 ppb. Most of the products containing these elevated levels have been reformulated or are no longer being manufactured. The FDA has concluded that the benzene levels found so far in beverages are not a safety concern for consumers. On July 12, 2007, the FDA posted an updated question and answer document on the occurrence of benzene in soft drinks and other beverages on their website [FDA question and answers on the occurrence of benzene in soft drinks](http://www.fda.gov/). No further updates on benzene in beverages in other jurisdictions have been noted.

Further details on past activities in other jurisdictions may be found in the Risk Mitigation Section of the [May 19, 2006 Health Risk Assessment](http://www.hc-sc.gc.ca/)

**Risk Management Options for Canada**

While the levels of benzene in beverages have generally remained low and the beverage industry has already taken measures to address these elevated levels, some types of beverage products (mainly concentrated products that are meant to be diluted before consumption) continue to contain elevated levels (although the resulting exposure in those cases would not constitute a health risk). Benzene is considered genotoxic and carcinogenic (although it is not known whether there is a genotoxic mode of action with respect to its carcinogenicity). As such, an ALARA (as low as reasonably achievable) approach is considered appropriate by Health Canada in cases such as this which involves a substance associated with a lifetime cancer risk and that has not been directly added to the food but is present for some other reason (e.g. [environmental contaminants](http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/contaminants/psl1-lsp1/benzene_e.pdf) or [food processing induced chemicals](http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/contaminants/psl1-lsp1/benzene_hra-ers_app1-eng.php)). In this regard, Health Canada and the Canadian Food Inspection Agency (CFIA) will continue to follow up with all companies whose product samples are found to contain elevated levels of benzene.

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