



Canadian Food
Inspection Agency

Agence canadienne
d'inspection des aliments

Perchlorate in Dairy Products and Infant Formula - April 1, 2020 to March 31, 2021

Food chemistry - Targeted surveys - Final report



Summary

Targeted surveys provide information on potential food hazards and enhance the Canadian Food Inspection Agency's (CFIA's) routine monitoring programs. These surveys provide evidence regarding the safety of the food supply, identify potential emerging hazards, and contribute new information and data to food categories where it may be limited or non-existent. They are often used by the agency to focus surveillance on potential areas of higher risk. Surveys can also help to identify trends and provide information about how industry complies with Canadian regulations.

Perchlorate is a chemical that occurs naturally in the environment (for example, in some nitrate fertilizers and potash deposits, and in the atmosphere)¹. It is also considered an environmental contaminant that is industrially produced, originating from the inappropriate storage or disposal of perchlorate used in the production of rocket propellants, explosives, road flares, fireworks, automotive airbags and some fertilizers^{2,3,4}. Since perchlorate readily dissolves in water, it can accumulate in groundwater and surface waters in areas where products containing perchlorate are manufactured or used on land previously treated with perchlorate-containing fertilizers. Leached perchlorate from soil and groundwater can be taken up and accumulated by plants, particularly the leafy portions of several food crops. As such, through the consumption of perchlorate-contaminated feed or water, perchlorate may also accumulate in animal meat and milk⁵. At sufficiently high doses, perchlorate can interfere with the uptake of iodide by the thyroid gland⁶. This can affect the production of thyroid hormones, which have a role in regulating many metabolic and developmental functions in humans⁶.

The goal of this survey was to generate further baseline surveillance data on the presence and levels of perchlorate in selected foods available on the Canadian retail market. A total of 493 samples were collected from retail stores in 6 cities across Canada. The samples collected included dairy products (cheese, cream, milk, yogurt) and infant formula. Perchlorate was detected in 84% of the survey samples and levels ranged from 1.1 ppb (parts per billion) to 110 ppb. The highest levels of perchlorate were found in concentrated infant formula samples, as they were tested as sold rather than diluted as needed for consumption. Yogurt had the highest average concentration of perchlorate amongst the ready-to-eat products. Comparison of the data from this survey to that from the previous targeted surveys showed that the levels of perchlorate in Canadian retail products are comparable to those previously reported.

The levels of perchlorate observed in this survey were evaluated by Health Canada who determined that none of the samples would pose a human health concern.

What are targeted surveys

Targeted surveys are used by the CFIA to focus its surveillance activities on areas of highest health risk. The information gained from these surveys provides support for the allocation and prioritization of the agency's activities to areas of greater concern. Originally started as a project under the Food Safety Action Plan (FSAP), targeted surveys have been embedded in our regular surveillance activities since 2013. Targeted surveys are a valuable tool for generating information on certain hazards in foods, identifying and characterizing new and emerging hazards, informing trend analysis, prompting and refining health risk assessments, highlighting potential contamination issues, as well as assessing and promoting compliance with Canadian regulations.

Food safety is a shared responsibility. We work with federal, provincial, territorial and municipal governments and provide regulatory oversight of the food industry to promote safe handling of foods throughout the food production chain. The food industry and retail sectors in Canada are responsible for the food they produce and sell, while individual consumers are responsible for the safe handling of the food they have in their possession.

Why did we conduct this survey

Perchlorate is a chemical that occurs naturally in the environment (for example, in some nitrate fertilizers and potash deposits, and in the atmosphere)¹. It is also considered an environmental contaminant that is industrially produced, originating from the inappropriate storage or disposal of perchlorate used in the production of rocket propellants, explosives, road flares, fireworks, automotive airbags and some fertilizers^{2,3,4}. Since perchlorate readily dissolves in water, it can accumulate in groundwater and surface waters in areas where products containing perchlorate are manufactured or used on land previously treated with perchlorate-containing fertilizers. Leached perchlorate from soil and groundwater can be taken up and accumulated by plants, particularly the leafy portions of several food crops. As such, through the consumption of perchlorate-contaminated feed or water, perchlorate may also accumulate in animal meat and milk⁵. Dairy products are highly consumed by young children in particular and results of the U.S. Food and Drug Administration's Total Diet Survey found that infants and children had the highest estimated intakes of perchlorate due to generally greater food and water consumption relative to body weight³.

At sufficiently high doses, perchlorate can interfere with the uptake of iodide by the thyroid gland⁶. This can affect the production of thyroid hormones, which have a role in regulating many metabolic and developmental functions in humans⁶.

Perchlorate has also been found in milk-based and soy-based infant formula. Given that dairy products and infant formulae are staples of the Canadian diet, this targeted survey

was designed to generate further baseline surveillance data on perchlorate levels in these products available at the Canadian retail level.

Currently, no Maximum Limits (MLs) for perchlorate have been established by Health Canada for perchlorate in food and therefore, compliance with Canadian regulations was not evaluated in this survey.

What did we sample

A variety of domestic and imported dairy products (cheese, cream, milk, yogurt) and infant formula samples were sampled between April 1, 2020 and March 31, 2021. Samples of products were collected from local/regional retail locations in 6 major cities across Canada. These cities encompassed 4 Canadian geographical areas:

- Atlantic (Halifax),
- Quebec (Montreal),
- Ontario (Toronto, Ottawa)
- West (Vancouver, and Calgary)

The number of samples collected from these cities was in proportion to the relative population of the respective areas. The shelf life, storage conditions, and the cost of the food on the open market were not considered in this survey.

Table 1. Distribution of samples based on product type and origin

Product type	Number of domestic samples	Number of imported samples	Number of samples of unspecified ^a origin	Total number of samples
Cheese	51	23	44	118
Cream	34	1	5	40
Infant formula	1	155	0	156
Milk	37	1	2	40
Yogurt	110	1	28	139
Total	233	181	79	493

^a Unspecified refers to those samples for which the country of origin could not be assigned from the product label or available sample information

How were samples analyzed and assessed

Samples were analyzed by an ISO/IEC 17025 accredited CFIA food testing laboratory. The results presented represent finished food products as sold and not as they would be consumed, whether the product sampled is considered an ingredient or requires preparation prior to consumption.

In the absence of established tolerances or standards for furans in foods, elevated levels of in specific foods may be assessed by HC on a case-by-case basis using the most current scientific data available.

What were the survey results

Of the 493 samples of dairy products (cheese, cream, milk, yogurt) and infant formula tested, 385 (84%) were found to contain perchlorate, with concentrations ranging from 1.1 ppb to 110 ppb and an average level of 7.3 ppb. Table 2 summarizes perchlorate results by product type for the current survey. Dairy products had slightly higher occurrence compared to infant formula. The highest levels of perchlorate were found in infant formula samples, since they were tested as sold and not as prepared. When the manufacturer’s recommended preparation instructions are taken into consideration (dilution factor of about 7), infant formula has the lowest average concentration of perchlorate. Yogurt had the highest average concentration of perchlorate amongst the ready-to-eat products.

Table 2. Summary of targeted survey results on perchlorate in dairy products and infant formula

Product type	Number of samples	Number of samples (%) with detected levels	Minimum (ppb)	Maximum (ppb)	Average ^b (ppb)
Cheese	118	90 (76)	1.1	16	4.6
Cream	40	37 (93)	1.6	11	4.9
Infant formula	156	113 (72)	1.6	110	13.4
Milk	40	36 (90)	2.1	9.9	5.0
Yogurt	139	138 (99)	2.1	16	5.4
Total	493	414 (84)	1.1	110	7.3

^b Only positive results were used to calculate the average levels

What do the survey results mean

Table 3 compares the data from this survey with that from previous targeted surveys^{7,8,9}. For all product types, perchlorate levels found were comparable to the levels reported in previous survey years. Perchlorate occurrence rates observed for individual product types also closely matched those observed previously.

Table 3. Minimum, maximum and average concentration of perchlorate from various survey years

Product type	Survey year	Number of samples	Minimum (ppb)	Maximum (ppb)	Average ^c (ppb)
Cheese	2020	118	1.1	16	4.6
Cheese	2013	20	3	42	9.0
Cheese	2010	23	2	24	5.1
Cream	2020	40	1.6	11	4.9
Cream	2012	9	3	7	4.0
Cream	2011	8	3	6	4.3
Infant formula	2020	156	1.6	110	13.4
Infant formula	2013	30	2	64	16.5
Infant formula	2011	68	2	33	11.8
Infant formula	2010	74	2	22	10.4
Milk	2020	40	2.1	9.9	5.0
Milk	2010	42	2	9	5.1
Yogurt	2020	139	2.1	16	5.4
Yogurt	2013	30	2	11	4.9
Yogurt	2010	24	2	12	5.1

^c Only positive results were used to calculate the average (hazard) levels

Dairy products

Dairy products have been included in all 5 years of perchlorate surveys. The levels are generally comparable between survey years. Although maximum perchlorate concentrations observed vary slightly from year to year, most dairy product tested throughout the years had perchlorate concentrations below 16 ppb⁷, which was the maximum concentration observed in dairy products in this survey year. Historically only 2 samples of cheese had perchlorate levels higher than 16 ppb.

Infant formula

Infant formula products have been sampled in all but one surveys on perchlorate. The samples included soy- and dairy-based infant formulas, and were in the form of powders, liquid concentrates, and ready-to-serve liquids. In this survey, the range of perchlorate concentrations are consistent between soy- and dairy-based formulas, with an exception of one milk-based formula product (3 samples with different lot numbers). When this product is excluded, the average concentration of perchlorate in all samples (including

negative results) are the same for soy- and dairy-based infant formulas. The average of positive results is higher for soy-based infant formula. These trends are consistent with previous survey years. Note that powdered products are expected to contain higher levels of perchlorate; therefore, the perchlorate levels in infant formula should not be compared to other product types without considering the dilution factor.

The levels of perchlorate observed in this survey were evaluated by Health Canada who determined that none of the samples would pose a human health concern.

References

1. [Joint FAO/WHO Food Standards Programme Codex Committee on Contaminants in Foods: Working Document for Information and Use in Discussions Related to Contaminants and Toxins in the GSCTFF.](#) (2011). Codex Alimentarius Commission.
2. Krska, R., Becalski, A., Braekevelt, E., Koerner, T., Cao, X., Dabeka, R., Godefroy, S., Lau, B., Moisey, J., Rawn, D.F.K., Scott, P.M., Wang, Z. and Forsyth, D. (2012). [Challenges and trends in the determination of selected chemical contaminants and allergens in food.](#) Analytical and Bioanalytical Chemistry, 402, pp. 139-162.
3. Murray, C.M., Egan, S.K., Kim, H., Beru, N. and Bolger, P.M. (2008). [U.S. Food and Drug Administration's Total Diet Study: Dietary intake of perchlorate and iodine.](#) Journal of Exposure Science and Environmental Epidemiology. Journal of Exposure Science and Environmental Epidemiology, 18, pp. 571-580.
4. [Perchlorate.](#) (2015). Health Canada. Canada.
5. Jackson, W.A., Joseph, P., Laxman, P., Tan, K., Smith, P.N., Yu, L., and Anderson, T.A. (2014). [Perchlorate Accumulation in Forage and Edible Vegetation.](#) Journal of Agricultural and Food Chemistry, 53, pp. 369-373.
6. Charnley, G. (2008). [Perchlorate: Overview of risks and regulation.](#) Food and Chemical Toxicology, 46, pp. 2307-2315.
7. 2013-2014 Perchlorate in Selected Foods. Canada. Canadian Food Inspection Agency. [unpublished data]
8. 2011-2013 Perchlorate in Fresh Fruits and Vegetables, Fruit and Vegetable Juice, Dairy-based products and Infant Formulas. Canada. Canadian Food Inspection Agency. [unpublished data]
9. 2010-2011 Perchlorate in Selected Foods. Canada. Canadian Food Inspection Agency. [unpublished data]