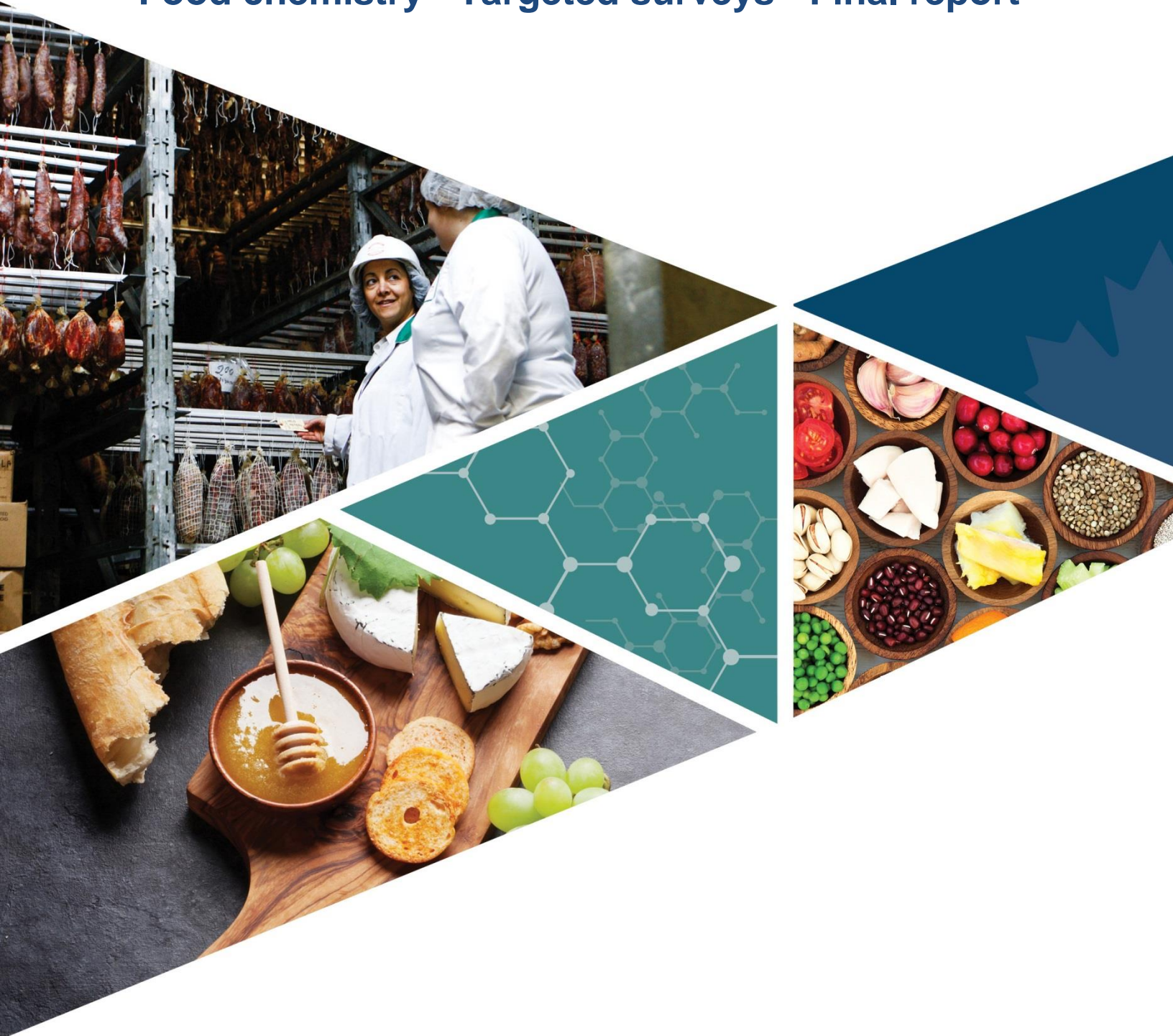![Canadian Food Inspection Agency / Agence canadienne d'inspection des aliments]

Toxic Metals in Ready-to-Eat Meals and Seaweed Products - April 1, 2019 to March 31, 2020

Food chemistry - Targeted surveys - Final report

Canada

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.

Chemical hazards in foods can come from a variety of sources. Metals are naturally-occurring elements that may be present in very low amounts in rock, water, soil, or air. Finding these substances in food products is not unexpected as trace levels generally reflect normal accumulation from the environment. They may be present in finished foods due to their presence in the ingredients used to manufacture those foods, and/or may be unintentionally incorporated along the food production chain. Metals of highest concern to human health include arsenic, cadmium, lead, and mercury and these have been shown to have effects on human health following long term exposure[1].

The main objectives of this targeted survey were to generate additional baseline surveillance data on the level of metals in foods not routinely monitored under other CFIA programs, and to compare, the detection rate of metals in foods in this survey with that of previous targeted surveys.

A total of 993 samples of ready-to-eat (RTE) meals and seaweed products were collected from retail locations in 11 cities across Canada and tested for metals/elements. Only the results of the metals of highest concern (arsenic, cadmium, lead, and mercury) are presented in this report. Mercury and cadmium had the lowest and the highest detection rate, respectively. Most (80%) of the survey samples contained one or more metals, while 24% of the samples contained traces of all four toxic metals. Highest levels of these metals were found in seaweed samples. Detectable levels of all four metals were found in 91% of seaweed products. The detection rates and the levels of metals reported in this targeted survey were comparable to those previously found in similar product types. There are no regulations in Canada for metal levels in the products tested. Health Canada determined that none of the samples analyzed for metals in this survey posed a concern to human health.

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

Chemical hazards in foods can come from a variety of sources. Metals are naturally-occurring elements that may be present in very low amounts in rock, water, soil, or air. Finding these substances in food products is not unexpected as trace levels generally reflect normal accumulation from the environment. They may be present in finished foods due to their presence in the ingredients used to manufacture those foods, and/or may be unintentionally incorporated along the food production chain.

Metals of highest concern to human health include arsenic, cadmium, lead, and mercury and these have been shown to have effects on human health following long term exposure. The human health effects depend on the metal, its concentration in the food, and other possible exposure effects/sources[1]. Manufacturers are responsible for measures aimed at reducing accidental introduction of these elements in foods.

The main objectives of this targeted survey were to generate additional baseline surveillance data on the level of metal levels in foods not routinely monitored under other CFIA programs, and to compare the detection rate of metals in foods in this survey with that of previous targeted surveys. Only the results of the metals of highest concern (arsenic, cadmium, lead, and mercury) are presented in this report.

What did we sample

A variety of domestic and imported RTE meals (fish/meat/pasta meals, pizza products, and complete infant/toddler meals) and seaweed products (fresh, roasted, dried/dehydrated, soups and snacks) were sampled between April 1, 2019 and March 31, 2020. Samples of products were collected from local/regional retail locations located in 11 major cities across Canada. These cities encompassed 4 Canadian geographical areas:

- Atlantic (Halifax and Moncton)
- Quebec (Montreal and Quebec City)
- Ontario (Toronto and Ottawa)
- West (Calgary, Saskatoon, Vancouver, Victoria and Winnipeg)

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 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
RTE meals - Adult	175	253	107	535
RTE meals - Infant/Toddler	8	161	39	208
Seaweed products	9	210	31	250
Total	**192**	**624**	**177**	**993**

[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 food testing laboratory under contract with the Government of Canada. The results are based on the food products as sold and not necessarily as they would be consumed, whether the product sampled is considered ingredient or requires preparation prior to consumption (for example, mixing with liquid or other ingredients).

Contaminants and other adulterating substances in foods have regulatory maximum levels. In 2014, Health Canada updated regulatory tolerances for arsenic and lead in a variety of ready-to-serve beverages, and infant formula when ready-to-serve[2]. In the absence of a specific maximum level, the levels of arsenic, cadmium, mercury and lead may be assessed by Health Canada on a case-by-case basis using the most current scientific data available.

What were the survey results

A total of 993 samples of RTE meals and seaweed products were analysed for arsenic, cadmium, lead and mercury. Most (80%) of the survey samples contained one or more metals, while 24% of the samples contained traces of all four metals. While 91% of seaweed samples contained traces of all four metals, only 1.3% of RTE products had detectable levels of all toxic metals. At least one of the four toxic metals was detected in 74% of the RTE meal samples.

Table 2. Detected levels of metals in RTE meals and seaweed products

| Product type	Number of samples	% positive for arsenic	Average level (range) of arsenic (ppm)	% positive for cadmium	Average level (range) of cadmium (ppm)	% positive for lead	Average level (range) of lead (ppm)	% positive for mercury	Average level (range) of mercury (ppm)
RTE meals - Adult	535	28	0.0409 (<LOD-0.950)	66	0.0163 (<LOD-0.133)	10	0.0327 (<LOD-0.295)	10	0.0041 (<LOD-0.135)
RTE meals - Infant/Toddler	208	30	0.0346 (<LOD-0.428)	35	0.0154 (<LOD-0.030)	6	0.0117 (<LOD-0.0207)	11	0.0021 (<LOD-0.006)
Seaweed products	250	99.6	27.4 (<LOD-110)	99.6	1.48 (<LOD-4.99)	97	0.146 (<LOD-1.12)	91	0.0095 (<LOD-0.085)

ppm = parts per million
Note: Average values were calculated using only results for samples with quantifiable metal levels

Arsenic

Arsenic was detected in 46% of samples tested in this targeted survey. Seaweed products had the highest (99.6%) percentage of samples with detectable levels of arsenic, followed by RTE meals for adults (30%) and infants/toddlers (28%). Figure 1 illustrates the range of arsenic levels by product type. Seaweed products had a much wider range of arsenic levels detected than other product types. Although RTE meal samples had much lower arsenic levels, among those samples, above average levels were often observed in RTE meals and soups containing fish and seafood.

Figure 1. Distribution of arsenic levels by product type
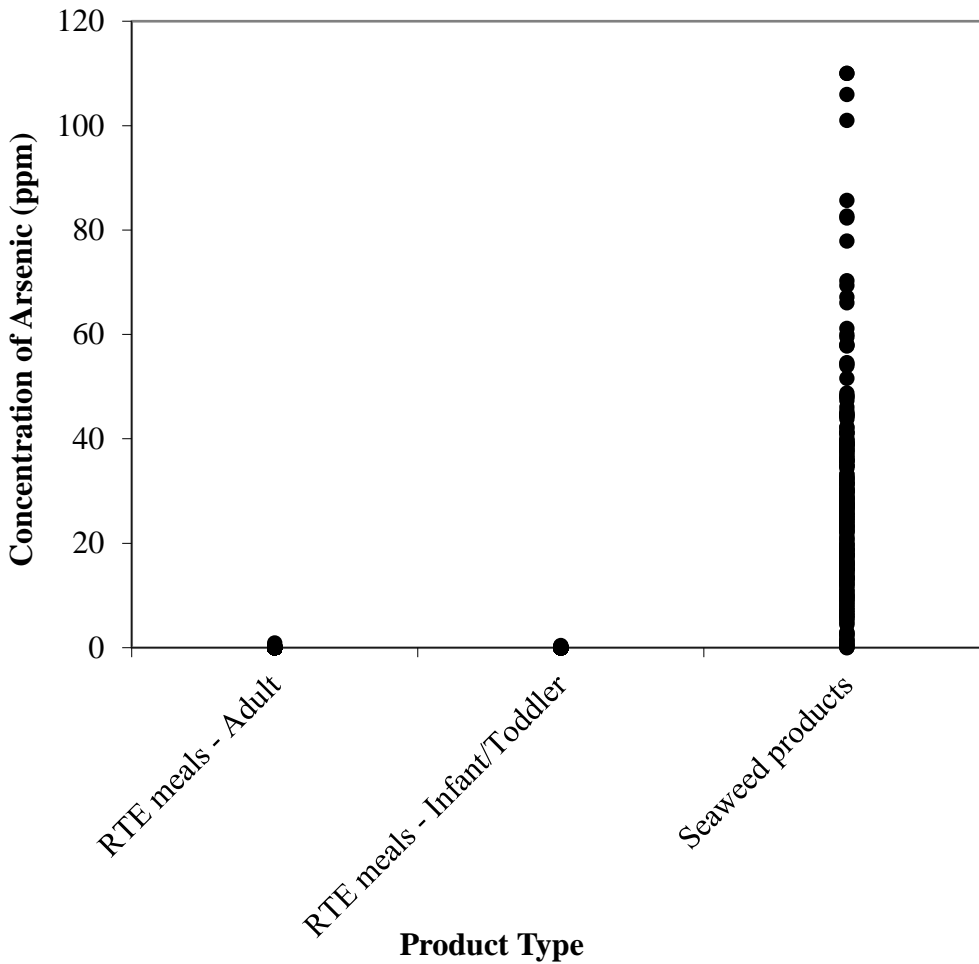
Cadmium

Cadmium had the highest overall detection rate; it was detected in 673 (68%) samples. Figure 2 illustrates the range of cadmium levels by product type. Seaweed products had a much wider range of cadmium levels detected than other product types with highest level of cadmium at 4.99 ppm. Seafood and grains are commodities known to contain higher levels of cadmium[3]. Consequently, RTE meals containing seafood (chowder) and grains had higher levels of cadmium than other RTE foods tested.

Figure 2. Distribution of cadmium levels by product type
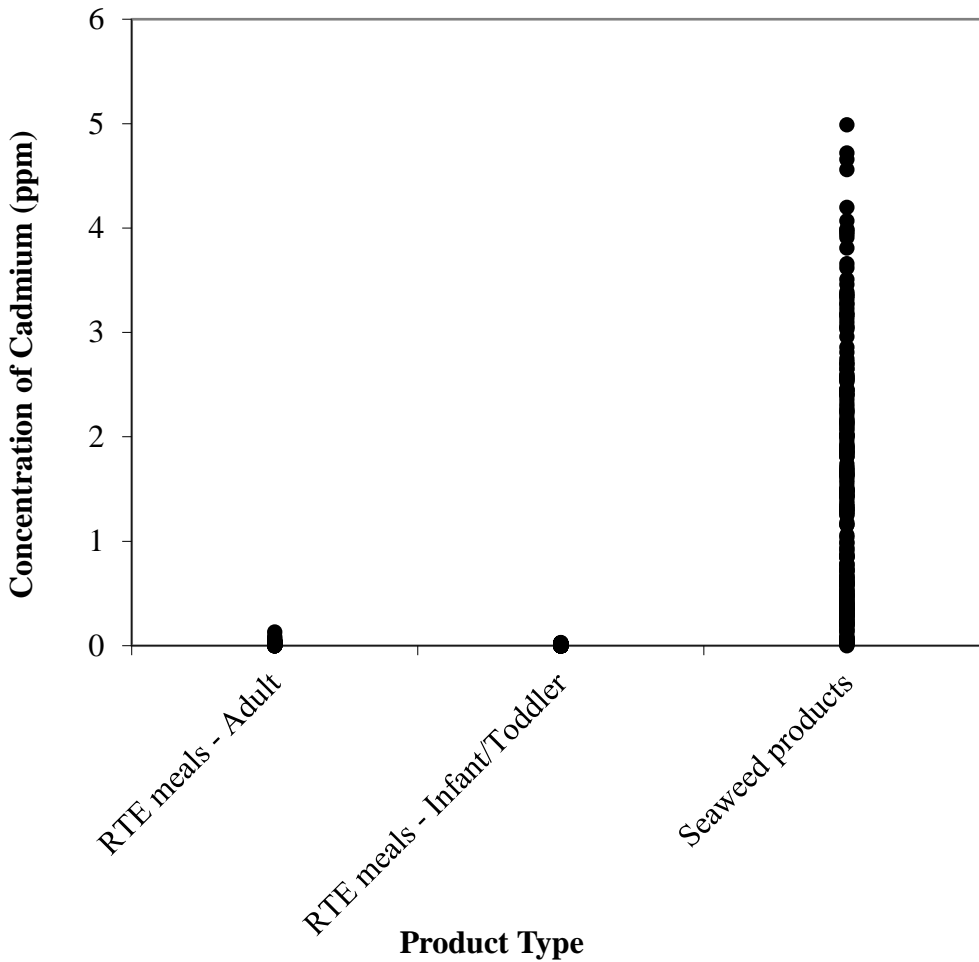
Lead

Lead was detected in 31% of samples tested in this survey. While lead was detected in 97% of seaweed samples, only 6% of RTE toddler and infant meals contained a detectable level of lead. Lead levels detected in these toddler and infant products were relatively low, with a maximum level of 0.0207 ppm, while the highest level of lead detected in in RTE adult meals was 0.295 ppm. The highest level of lead in this survey (1.12 ppm) was detected in a sample of dry wakame (a type of edible seaweed).

Figure 3. Distribution of lead levels by product type
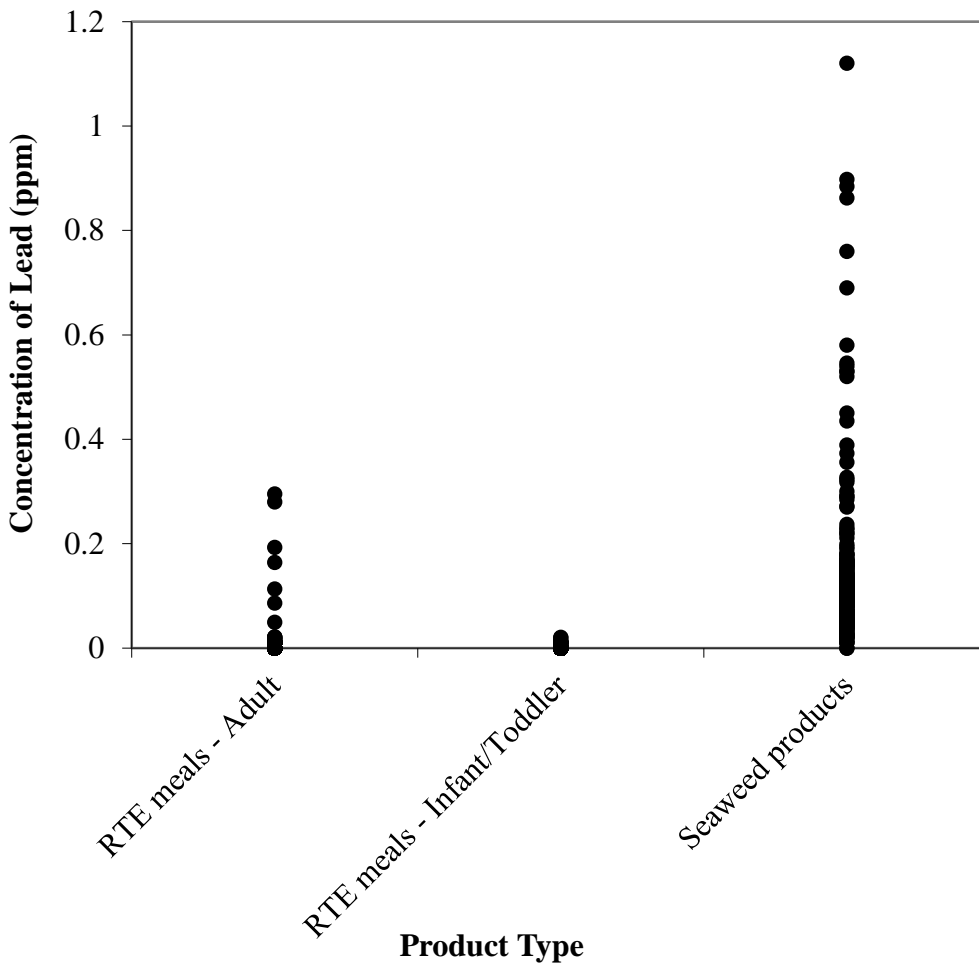
Mercury

Mercury had the lowest overall detection rate; it was detected in 30.7% of samples tested in this survey. The detection rate was highest for seaweed products (91%) and relatively low in RTE meals (10%). Figure 4 illustrates the range of mercury levels detected by product type. Although the highest level of mercury was detected in a sample of fish-based RTE meal, seaweed products had the highest average level of mercury.

Figure 4. Distribution of mercury levels by product type
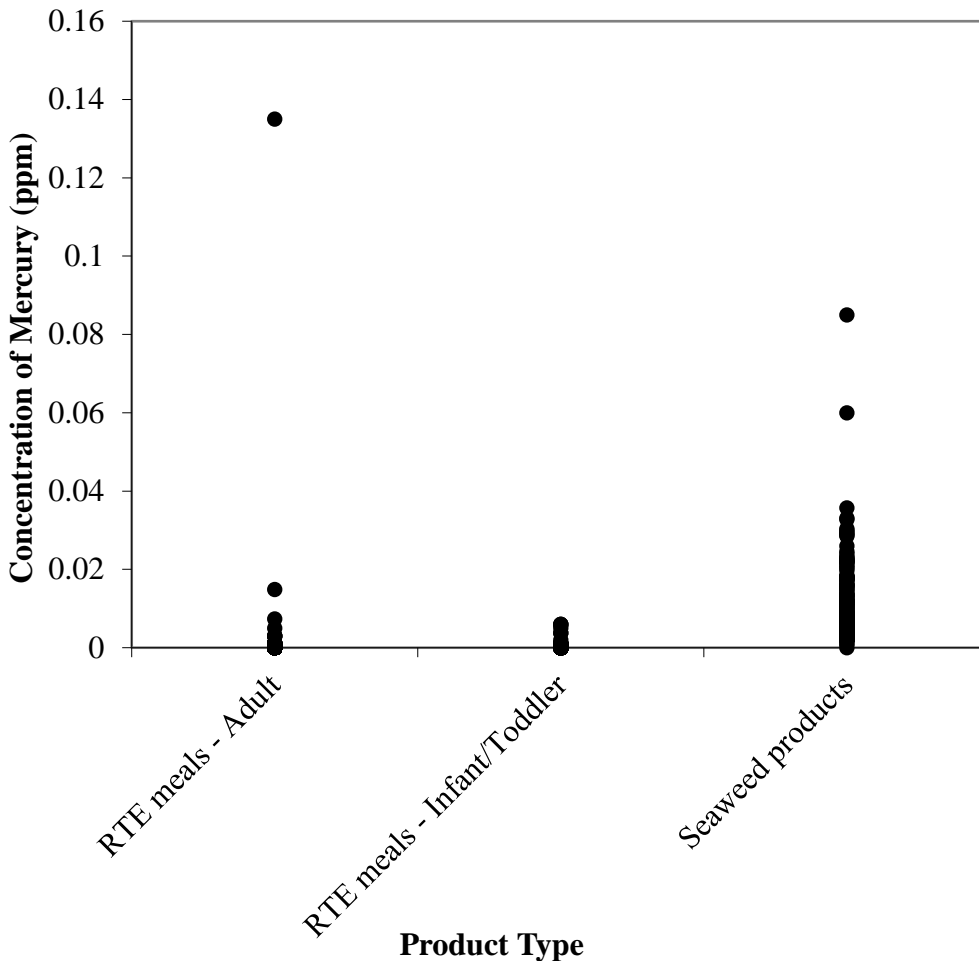
What do the survey results mean

The detection rates and the levels of metals reported in this targeted survey were comparable to those previously found in these product types[4,5,6,7,8,9,10,11]. Some differences observed may be due to the sample size and the specific type of product tested. The increase in the detection rates between the surveys years were associated mainly with a more sensitive method and the types of products tested. As previously observed in the CFIA surveys, seaweed products were more likely to contain detectable levels of toxic metals than other commodities. High levels of metals in seaweed products were consistent with the fact that seaweeds can rapidly accumulate elevated concentrations of metals from the contaminated aquatic environment[12]. The drying process is known to further concentrate metal contaminants . It is also expected that the highest levels of metals were detected in products in which seaweed was the only or the main ingredient. It should be noted that these seaweed samples were analyzed as sold and not as

consumed, therefore the levels of metal found in these samples may not be comparable to ready-to-serve products or in products with seaweed as an ingredient.

As previously observed[5,6], RTE meals were associated with relatively low detection rate and low levels of the metals. Among those products, grain products and RTE meals containing fish and seafood (due to bioaccumulation of metals) were often found to contain the highest detected levels of toxic metals. This survey also confirmed that toddler and infant products are often less likely to contain these metals, likely due to more careful ingredient selection by the manufacturers.

Table 3. Metal testing results from various survey years

Product type	Year	Number of samples	% positive for arsenic	Average level (maximum) of arsenic (ppm)	% positive for cadmium	Average level (maximum) of cadmium (ppm)	% positive for lead	Average level (maximum) of lead (ppm)	% positive for mercury	Average level (maximum) of mercury (ppm)
RTE meals - Adult	2019	535	28	0.0409 (<LOD-0.950)	66	0.0163 (<LOD-0.133)	10	0.0327 (<LOD-0.295)	10	0.0041 (<LOD-0.135)
RTE meals - Infant/Toddler	2019	208	30	0.0346 (<LOD-0.428)	35	0.0154 (<LOD-0.030)	6	0.0117 (<LOD-0.0207)	11	0.0021 (<LOD-0.006)
RTE meals	2018	740	6	0.094 (<LOD-0.507)	33	0.015 (<LOD-0.075)	2	0.034 (<LOD-0.134)	8	0.0012 (<LOD-0.016)
RTE meals	2016	2000	54	0.0067 (<LOD-0.808)	96	0.0095 (<LOD-0.337)	92	0.0042 (<LOD-0.082)	38	0.00014 (<LOD-0.024)
Seaweed products	2019	250	99.6	27.4 (<LOD-110)	99.6	1.48 (<LOD-4.99)	97	0.146 (<LOD-1.12)	91	0.0095 (<LOD-0.085)
Seaweed products	2013	65	100	22.4 (1.05-50.15)	100	1.72 (0.044-4.96)	98.5	0.229 (<LOD-1.43)	55.4	0.0143 (<LOD-0.036)
Seaweed products	2011 and 2012 (Cadmium survey)	189	100	23.1 (2.82-101.8)	100	1.75 (0.025-6.40)	100	0.230 (0.030-2.17)	76.7	0.0130 (<LOD-0.040)
Seaweed products	2011 and 2012 (Arsenic survey)	145	100	29.6 (0.041-181.5)	N/A	N/A	N/A	N/A	N/A	N/A
Seaweed products	2010	90	100	26.9 (1.13-91.3)	N/A	N/A	N/A	N/A	N/A	N/A

Note: Average values were calculated using only results for samples with quantifiable metal levels

LOD: limit of detection

N/A: not available; not tested for in this survey

All levels of metals found in the products tested in this survey were evaluated by Health Canada and deemed safe for consumption by Canadians.

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