Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

Lead Chromates in Spices - April 1, 2019 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.

There is increasing awareness of food adulteration within the food industry. Food adulteration or misrepresentation is the intentional and deliberate substitution, dilution, counterfeiting or misrepresentation of food, ingredients or packaging, or labels containing false or misleading statements about the product itself for economic gain[1]. This means the consumer could be paying more for a product that isn't what it claims to be. Unidentified allergens or hazardous materials added to food products could pose a health risk to consumers.

Lead chromate is a lead-based chemical that has been used illegally to add or enhance colour to brightly colored yellow spices such as turmeric[2]. Lead occurs naturally in the environment and consumers are exposed to low levels of lead in food, drinking water, air, dust and soil[3]. It is neurotoxic, can cause anaemia, hypertension, immunotoxicity and can be toxic to kidneys and reproductive organs[4]. This survey was created to monitor lead chromate adulteration in spices available on the Canadian retail market. There is no Health Canada (HC) established maximum limit for lead in spices.

Chromium is a naturally occurring element in rocks, plants, soil, animals, volcanic dust and gases[5]. It occurs in the environment in 2 main forms; trivalent chromium (Cr III) and hexavalent chromium (Cr VI)[5]. Exposure to chromium is mainly through ingestion of food and water and inhalation[5]. Cr III is an essential mineral in humans necessary for glucose, protein and fat metabolism[5]. Cr VI is most commonly produced by industrial processes and can be found in lead chromate[6]. Cr VI is toxic and carcinogenic and can cause gastrointestinal, respiratory and neurological issues[6]. There is no HC established maximum limit for chromium in spices.

A total of 132 yellow and brown coloured spice samples such as cumin powder, curry powders and turmeric were collected from retail and tested for indications of adulteration with lead chromate. Two samples of ground ginger were found to contain levels of lead and chromium with ratios expected in lead chromate and had positive results for chromates, suggesting a potential adulteration. All results were reviewed by HC's Bureau of Chemical Safety who determined that none of the samples were considered a health risk to consumers.

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

There is increasing awareness of food adulteration within the food industry. Food adulteration or misrepresentation is the intentional and deliberate substitution, dilution, counterfeiting or misrepresentation of food, ingredients or packaging, or labels containing false or misleading statements about the product itself for economic gain[1]. This means that the consumer could be paying more for a product that isn't what it claims to be. Unidentified allergens or hazardous materials added to food products could pose a health risk to consumers.

Lead chromate is a lead-based chemical compound that has been used illegally to add or enhance colour to brightly coloured yellow spices such as turmeric[2]. Lead is neurotoxic, can cause anaemia, hypertension, immunotoxicity and can be toxic to kidneys and reproductive organs[4]. The toxic form of chromium, Cr VI can be found in lead chromate and is carcinogenic and can cause gastrointestinal, respiratory and neurological issues[5].

This survey was created to determine if there is lead chromate adulteration in spices available on the Canadian retail market by monitoring for elevated levels of lead and chromium and positive results for chromates.

What did we sample

A variety of domestic and imported yellow and brown coloured spices were sampled between April 1, 2019 and March 31, 2021. Samples of products were collected from local/regional retail

locations located in 6 major cities across Canada. These cities encompassed 4 Canadian geographical areas:

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

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

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

Product type	Number of organic samples	Number of domestic samples	Number of imported samples	Number of samples of unspecified origin*	Total number of samples
Cumin	10	0	15	8	23
Ginger	2	0	17	6	23
Mustard Powder	0	1	5	12	18
Spice blend	4	6	27	13	46
Turmeric	3	1	16	5	22
Grand total	**19**	**8**	**80**	**44**	**132**

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

How were samples analyzed and assessed

Samples were analyzed by an ISO/IEC 17025 accredited food testing laboratory. The results are based on the food products as sold and not necessarily as they would be consumed.

Samples were analyzed for the addition of lead chromate by testing for concentrations of lead and chromium in addition to a qualitative colorimetric test for chromates. Samples were deemed to contain lead chromate when positive levels of lead and chromium were found in a sample, the ratio of the level of lead to chromium was consistent with the ratio expected in lead chromate and a positive result was obtained from a qualitative colorimetric test for chromates. There are no HC established maximum limits for lead or chromium in spices.

What were the survey results

Lead exposure may occur from a number of environmental and food sources. Chronic exposure to lead can be harmful to human health. Lead is a naturally occurring metal found in rock and soil and has many industrial uses, such as in mining, smelting and battery manufacturing[7]. The greatest source of exposure to lead is oral exposure from food and water followed by inhalation[7]. Due to its presence in the environment, it is generally found in all foods at very low levels[7].

Chromium is a naturally occurring element in rocks, plants, soil, animals, volcanic dust and gases[5]. It occurs in the environment in 2 main forms: Cr III and Cr VI[5]. Exposure to chromium is mainly through ingestion of food and water and inhation[5]. Cr III is an essential mineral in humans necessary for glucose, protein and fat metabolism[5]. Cr VI is a toxic form of chromium most commonly produced by industrial processed and can be found in lead chromate[6]. Cr VI is carcinogenic and can cause gastrointestinal, respiratory and neurological affects[6].

Two samples of ground ginger were found to contain levels of lead and chromium with ratios expected in lead chromate and had positive results for chromates, suggesting a potential adulteration. All other samples analyzed in this survey were complaint and were not adulterated with lead chromate. A total of 120 samples contained measurable levels of lead and chromium at very low concentrations, 12 samples did not contain any measurable amount of lead and 1 sample did not contain any measurable amount of chromium.

The amount of lead found in samples ranged from not detected to 1.84 ppm. The average result of all samples was 0.31 ppm. These levels are consistent with levels of lead in spices from previous surveys[8]. The amount of total chromium found in samples ranged from not detected to 10.58 ppm with an average of 1.41 ppm. A total of 120 samples contained measurable levels of lead and chromium at very low concentrations, 12 samples did not contain any measurable amount of lead and 1 sample did not contain any measurable amount of chromium.

What do the survey results mean

All results from this survey were evaluated by HC’s Bureau of Chemical Safety who determined that none of the samples would pose an unacceptable human health concern. All samples were not considered a health risk and there were no recalls resulting from this survey.

References

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6. Sharma P., Singh S., Parakh S., Tong Y. (2022) Health hazards of hexavalent chromium (Cr (VI)) and its microbial reduction. Bioengineered. 13(3): 4923-4938.

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8. Lead Chromates in Spices - April 1, 2018 to March 31, 2019. (2022). Canada. Government of Canada.