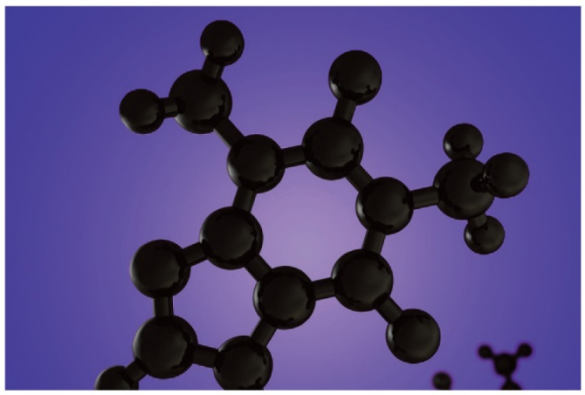
Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

Food Safety Action Plan

REPORT

2011-2012 Targeted Surveys

Chemistry



Food Colours in Selected Foods

TS-CHEM-11/12

Canada

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Executive Summary

The Food Safety Action Plan (FSAP) aims to modernize and enhance Canada's food safety system. As part of the FSAP enhanced surveillance initiative, targeted surveys are used to examine various foods for specific hazards.

The main objectives of this targeted survey was to provide baseline data regarding the presence and actual use levels of food colours in selected foods (candy, coloured snacks/chips, fresh oranges, marmalade, orange juice, ready-to-serve beverages, savoury sauces, spices, sweets and wasabi products) available on the Canadian retail market, and to compare current results with the results of previous FSAP targeted surveys on food colours, where feasible.

Food colours are widely used in the food industry for a variety of reasons, including: to compensate for the loss of natural colour(s) during processing; to achieve a uniform product colour; and to make the food more appealing and appetizing. Incorporation of food colours into processed foods makes them a food additive and as such, they are subject to premarket evaluation. Food additives are regulated in Canada under Marketing Authorizations (MAs) issued by the Minister of Health and the *Food and Drug Regulations*. Approved food additives and their permitted conditions of use are set out in the Lists of Permitted Food Additives on Health Canada's website that are incorporated by reference in the MAs. In Canada, ten synthetic colours have been approved for use in food, and are listed in Division 6 of the *Food and Drugs Regulations*. The presence of one or more approved colours in food is not unexpected.

Advances in detection methodologies have revealed the unexpected presence of non-permitted dyes in food. The presence of non-permitted colours may pose a health concern to the consumer, as some may be potential carcinogens. Also, while the biological mechanisms remain unclear, several reports have demonstrated hyperactive behaviour in children following consumption of mixtures of certain specific permitted food colours. Additionally, exposure to synthetic food colours has been reported to cause rash, flushing, asthma, dizziness and fainting.

In the current survey, a total of 1799 samples were collected and analyzed for up to 216 different food colours. Samples included 302 ready-to-serve beverages, 299 candy samples, 297 savoury sauces, 295 spices, 264 sweets, 145 fresh oranges, 52 marmalades, 49 coloured snacks/chips, 49 orange juices, and 47 wasabi products. Detectable levels of food colour(s) were found in all product types sampled. Twelve hundred and seventy-four of the 1799 samples (70.8%) did not have detectable levels of added food colours. Four hundred and eighty-six (486) samples contained detectable food colours in

compliance with the *List of Permitted Colouring Agents*. Overall, the compliance rate in this targeted survey was 97.8%. When compared to the 2010-11 survey, these results show an increased rate of samples with no detectable food colours (64%) and a comparable rate of compliance (96.2%).

Thirty-nine samples were found to be in violation of Canadian regulations, totaling 41 violations (two samples had two distinct violations each). Coloured snacks/chips contained the highest percentage of samples with food colour violations at 10.2%, followed by sweets at 6.1%, savoury sauces at 3.0%, spices at 1.7%, candy at 1.0% and ready-to-serve beverages at 0.3%. Fresh oranges, marmalade, orange juice and wasabi products had no food colour violations in this survey.

All violations identified in the survey were minor and/or technical in nature and were referred to the appropriate program for potential follow-up. No product recalls were warranted.

1 Introduction

1.1 Food Safety Action Plan

In 2007, the Canadian government launched a five-year initiative in response to a growing number of product recalls and concerns about food safety. This initiative, called the Food and Consumer Safety Action Plan (FCSAP), aims to modernize and strengthen Canada's safety system for food, health, and consumer products. The FCSAP initiative unites multiple government partners in ensuring safe food for Canadians.

The Canadian Food Inspection Agency's (CFIA's) Food Safety Action Plan (FSAP) is one element of the government's broader FCSAP initiative. The goal of FSAP is to identify risks in the food supply, limit the possibility that these risks occur, improve import and domestic food controls and identify food importers and manufacturers. FSAP also looks to verify that the food industry is actively applying preventive measures, and that there is a rapid response when/if these measures fail.

Within FSAP, there are 12 main areas of activity, one of which is risk mapping and baseline surveillance. The main objective of this area is to better identify, assess, and prioritize potential food safety hazards through risk mapping, information gathering, and testing of foods from the Canadian marketplace. Targeted surveys are one tool used to test for the presence and level of a particular hazard in specific foods.

Within the current regulatory framework, some commodities (such as meat and fish products) traded internationally and interprovincially are regulated by specific Acts. These are referred to as federally registered commodities. Under the current regulatory framework, the non-federally registered commodities encompass 70% of domestic and imported foods that are regulated solely under the *Food and Drugs Act* and *Regulations*. Targeted surveys are primarily directed towards non-federally registered commodities.

1.2 Targeted Surveys

Targeted surveys are used to gather information regarding the occurrence and extent of chemical residues, contaminants, and/or natural toxins in defined food commodities. The surveys are designed to provide data to respond to specific concerns; therefore, unlike monitoring activities, testing of a particular chemical hazard is targeted to commodity types and/or geographical areas.

Due to the vast number of chemical hazards and food commodity combinations, it is not possible, nor should it be necessary, to use targeted surveys to identify and quantify all chemical hazards in foods. To identify food-hazard combinations of greatest potential health risk, the CFIA uses a combination of scientific literature, media reports, and/or a risk-based model developed by the Food Safety Science Committee, a group of federal, provincial, and territorial subject matter experts in the area of food safety.

This survey is a follow-up to the 2010-2011 Food Colours in Selected Foods survey and a further examination of domestic and imported products likely to contain detectable levels of food colours. Additionally, oranges and orange products (marmalade and orange juice) were analysed for the presence of Citrus Red 2 to resolve whether it is still commonly being used by citrus growers, and that levels are compliant with Canadian regulations.

Results of this survey will be compared to the 2010-11 Food Colours in Selected Foods Survey results.

1.3 Acts and Regulations

The *Canadian Food Inspection Agency Act* stipulates that the CFIA is responsible for enforcing restrictions on the production, sale, composition and content of foods and food products as outlined in the *Food and Drugs Act* and the *Food and Drug Regulations*.

Health Canada establishes the health-based maximum levels for chemical residues, contaminants, and natural toxins in food sold in Canada. Certain maximum levels for chemical contaminants in food appear in the Canadian *Food and Drug Regulations*, where they are referred to as tolerances. There are also a number of maximum levels that do not appear in the regulations and are referred to as standards.

In Canada, food colours are considered food additives. Health Canada conducts detailed, rigorous, safety-focused pre-market evaluations of food additives prior to allowing their use in foods sold in Canada[1]. The *List of Permitted Colouring Agents*, which is incorporated by reference in the *Marketing Authorization for Food Additives That May Be Used as Colouring Agents*, stipulate the natural, inorganic, and synthetic colours permitted for use in specified foods sold in Canada, and the maximum allowable levels of use of those colours.[2] Some conditions respecting the maximum levels of use of certain synthetic colours are also set out in Part B, Division 6 of the FDR:

> **B.06.002.** No person shall sell a food, other than a synthetic colour, mixture, preparation or flavouring preparation, that contains, when prepared for consumption according to label directions, more than

(*a*) 300 parts per million of Allura Red, Amaranth, Erythrosine, Indigotine, Sunset Yellow FCF or Tartrazine or any combination of those colours unless a higher maximum level of use is specified in column III of item 3 of Table III to section B.16.100;

(*b*) 100 parts per million of Fast Green FCF or Brilliant Blue FCF or any combination of those colours;

(*c*) 300 parts per million of any combination of the synthetic colours named in paragraphs (*a*) and (*b*) within the limits set by those paragraphs; or

(*d*) 150 parts per million of Ponceau SX

Maximum levels for various food colours in specified foods exist in the European Union[3,4,5], the United States[6,7] , Australia and New Zealand[8], which are Canada's major trading partners. However, some of the food colours that are permitted in these countries are not allowed in foods sold in Canada. The FDR currently requires that food colours be declared in the ingredient list, but permits use of the general term "colour" to specify one or more colours. Declaration of individual colours by name is voluntary and at the manufacturer's discretion. However, Health Canada has proposed amending the Canadian food colour labelling regulations so that it would be a requirement to identify individual food colours on pre-packaged food product ingredient lists[9]. This regulatory amendment would provide consumers with more information, and help align Canadian standards with other international jurisdictions where individual declarations of food colour additives are often required.

With respect to the scope of this survey, there are three instances (singly or in combination) in which a food product may possibly be non-compliant when results are compared to the Canadian regulations on the use of food colours:

1. The concentration of food colour(s) observed in a product exceeds the maximum level(s) of use as per the *List of Permitted Colouring Agents*
2. The product contains food colour(s) not permitted for use in food sold in Canada
3. The product contains permitted food colour(s) when no declaration of use is made in the list of ingredients

Elevated levels of food colours in foods or the presence of non-permitted food colours may be assessed by Health Canada on a case-by-case basis using the most current scientific data available. Follow-up actions are initiated in a manner that reflects the magnitude of the health concern. Actions may include further analysis, notification to the

producer or importer, follow-up inspections, additional directed sampling, and recall of products.

2 Survey Details

2.1 Food Colour Additives in Food

2.1.1 General background

Food colours are either synthetic or natural. Synthetic food colours are produced by chemical processes and have no counterpart in nature. Natural food colours exist in nature, and may be extracted from foods or manufactured. Natural colours are generally more expensive to use, less vibrant in colour than synthetic colours, less concentrated in colour, and are more sensitive to light, temperature, and acidity[10].

Food colours are widely used by the food industry. In Canada they are regulated as food additives, and the *List of Permitted Colouring Agents* contains a comprehensive list of the natural, inorganic, and synthetic colours approved for use in foods sold in Canada. The permitted colours are identified by a "common name". The U.S. Food and Drug Administration similarly use common names, but also have FD&C names[7] for colours that meet U.S. certification requirements. The European Union uses E numbers to identify food colours[11].

2.1.2 Health effects

The presence of non-permitted food colours, particularly industrial dyes, may pose a health risk to the consumer, as some are potentially damaging to DNA and carcinogenic[12,13]. The use of permitted synthetic food colours may also be a potential concern to a small percentage of the population which has exhibited sensitivity to synthetic food colours, resulting in rash, flushing, asthma, dizziness and fainting[14,15]. Colours such as Tartrazine[16,17] and Ponceau 4R[18] have been responsible for adverse reactions in a small segment of the population. There is also evidence that certain food colours may cause an allergic reaction in some sensitive individuals[19]. Health Canada has recently proposed changes to food colour labelling requirements that would require food colours be identified on labels by their common name in order to address reports of these health effects, as well as requests by consumers that more information be made available when making food selections[9].

Furthermore, several studies have suggested a correlation between consumption of certain synthetic food colours (or mixes) and hyperactive behaviour in children, although this relationship has not been conclusively proven[20,21]. A variety of scientific studies have

been conducted to test this correlation, but the results have been inconsistent and inconclusive[22]. Despite the lack of a clear link, anecdotal information suggests that certain consumers are cautious about the use of synthetic food colour additives, primarily for health and safety reasons. With trends toward healthier lifestyles, the food industry is noting that consumers are demanding fewer artificial or synthetic ingredients in foods[23]. While natural colours have been detected in this survey, and are permitted for use in Canada, the scope of this survey encompasses synthetic food colour additives only.

2.2 Rationale

This targeted survey has been initiated in part by the potential health concerns associated with the incorporation of certain food colours into processed foods. Certain non-permitted food colours may potentially be damaging to DNA and carcinogenic[12,13]. Data on the actual use of food colours is lacking as CFIA has not had any large-scale, routine monitoring activities for food colours in finished foods. Targeted surveys focused on food colours have been carried out previously under the FSAP initiative, and will continue to focus on foods of imported origin and will serve to establish baseline data.

Additionally, increased public awareness prompted by media reports of apparent adverse health effects related to the consumption of synthetic food colours has further supported the rationale of this survey[20], which provides data on actual use levels of food colours.

2.3 Sample Distribution

The 2011-2012 Food Colours in Selected Foods targeted domestic and imported products likely to contain detectable levels of food colours. A total of 1799 samples were collected from grocery and specialty stores in 11 Canadian cities between April 2011 and March 2012.

The 1799 survey samples included 258 domestic products, 1430 imported products, and 111 products of unspecified origin. In general, an unspecified country of origin refers to those samples for which the origin could not be determined from the product label or sample information. It is important to note that the products sampled often contained the statement “imported for Company A in Country Y” or “manufactured for Company B in Country Z”, and though the labelling meets the intent of the regulatory standard, it does not specify the true origin of the product ingredients. Only those products labelled with a clear statement of “Product of”, “Prepared in”, “Made in”, “Processed in”, and “Manufactured by” were considered as being from a specific country of origin[24]. The samples originated in at least 55 countries, including Canada, with approximately 34.9% of the samples originating in either Canada or the United States. The distribution of samples collected in this survey with respect to the country of origin (as recorded on the sampling documentation or indicated on the product label) is presented in Table 1.

Table 1. Distribution of samples by category type and origin

Category	Number of Samples of Domestic Origin	Number of Imported Samples	Number of Samples of Unspecified* Origin	Total Number of Samples
Candy	36	234	29	299
Coloured Snacks/Chips	9	39	1	49
Fresh Oranges	0	145	0	145
Marmalade	16	34	2	52
Orange Juice	12	36	1	49
Ready-to-serve Beverages	60	224	18	302
Savoury Sauces	34	249	14	297
Spices	28	225	42	295
Sweets	63	197	4	264
Wasabi Products	0	47	0	47
Total	**258**	**1430**	**111**	**1799**

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

2.4 Analytical Methods

Samples in the food colours targeted survey were analyzed by an ISO 17025 accredited CFIA Laboratory using two analytical methods, one to identify water-soluble food colours, and the other to identify oil-dispersible food colours. Based on the nature of the food product, samples were analyzed for water-soluble colours, oil-dispersible colours, or both.

The water-soluble colors method allowed for the identification and quantification of 10 water-soluble colours permitted in Canada, and identification of an additional 187 distinct water-soluble colours (including non-permitted colours, natural colours, and subsidiary dyes), by liquid chromatography and photodiode array (LC-PDA) detection. The fat-soluble colors method allowed for the identification and quantification of 19 different oil-dispersible, permitted and non-permitted colours by LC-PDA detection. Please refer to Appendices A and B for detailed lists of colours targeted by these two methods.

Samples were tested as sold, meaning that the product was not prepared as per the package instructions (if applicable). If the food colour concentrations for some concentrated products appeared to be elevated (such as juice nectars), the appropriate

preparation (dilution) factors were applied as per the manufacturer's instructions to determine compliance.

For water-soluble food colours, the limit of detection (LOD) ranged from 0.08 ppm to 0.43 ppm (for 10 g sample weight) for all matrices tested. For fat-soluble dyes, the LOD ranged from 0.024 ppm to 0.1 ppm.

2.5 Limitations

This targeted survey was designed to provide a snapshot of the levels of food colours in selected foods available to Canadian consumers, and highlight commodities that warrant further investigation. The limited sample sizes analyzed represent a small fraction of the products available to consumers. Therefore, care must be taken when interpreting and extrapolating these results.

Distribution of samples by origin (as recorded by the sampler or indicated on the label) is presented to provide a general sense of the origin of samples. It is important to note, however, that Canadian companies may import raw or intermediate materials for use as ingredients, for blending, or for further processing for resale into Canadian and export markets. In some of these cases, products may be considered to be of Canadian, or domestic, origin. Determination of country of origin is further complicated by the fact that ingredients are often sourced from different or multiple countries. Country of origin was assigned for 1688 samples (otherwise designated as "unspecified") based on information provided on the documentation accompanying the sample or indicated on the product label. As a result, few inferences or conclusions were made regarding the data with respect to country of origin. Regional differences, impact of product shelf-life, packaging and storage conditions, or cost of the commodity on the open market were also not examined in this survey.

3 Results and Discussion

3.1 Overview of Survey Results

Overall, 97.8% of the samples were compliant with Canadian food colour regulations (i.e. food colours were not detected or sample contained permitted food colour additives at levels that respect the applicable Canadian regulations). Of the 1799 samples, 1274 (71%) did not have detectable levels of food colours. Thirty-nine samples were in violation of Canadian food colour additive regulations; with a total of 41 violations (two samples had two distinct violations each). Refer to Appendix C for a summary of the food colour violations found in the product types sampled in this survey.

Detectable levels of food colours were found in all product types sampled. A total of 15 different food colors were detected in the samples over the course of the survey. Please refer to Table 2 below for a summary of food colours detected and the prevalence of each colour.

Table 2 - Food colours detected and the number of samples in which the colour was detected

Food colours detected in survey samples (Permitted and *non-permitted*)	**Number of samples in which colour was detected†**
Tartrazine	358
Allura Red	329
Brilliant Blue FCF	292
Sunset Yellow FCF	252
Erythrosine	56
Indigotine	50
2,4,5 and/or 2,4,7-Triiodofluorescein*	18
Amaranth	17
*New Coccine (Ponceau 4R)**	8
*Azorubine (Chromotrope FB)**	3
*Orange II**	2
*Chrysoidine G**	1
Citrus Red*	1
Fast Red E	1
*Patent Blue Violet**	1

†Samples may contain more than one food colour additive, natural colour, or dye
**Semi-quantitative detection*

Coloured snacks/chips contained the highest percentage of samples with food colour violations at 10.2%, followed by sweets at 6.1%, savoury sauces at 3.0%, spices at 1.7%, candy at 1.0% and ready-to-serve beverages at 0.3% of samples tested. As noted in section 1.3, there are three instances (singly or in combination) in which a food product may possibly be non-compliant with Canadian regulations for use of food colour additives:

- The concentration of food colour(s) observed in a product exceeds the maximum level(s) of use as per the *List of Permitted Colouring Agents*
- The product contains a food colour not permitted for use in food sold in Canada
- The product contains permitted food colour when no declaration of use is made in the list of ingredients

The most common type of violation noted in this survey was that levels of permitted and declared food colours were in excess of the maximum levels of use permitted by regulations. Figure 1 below presents the number of violations and type of violation for each product type.

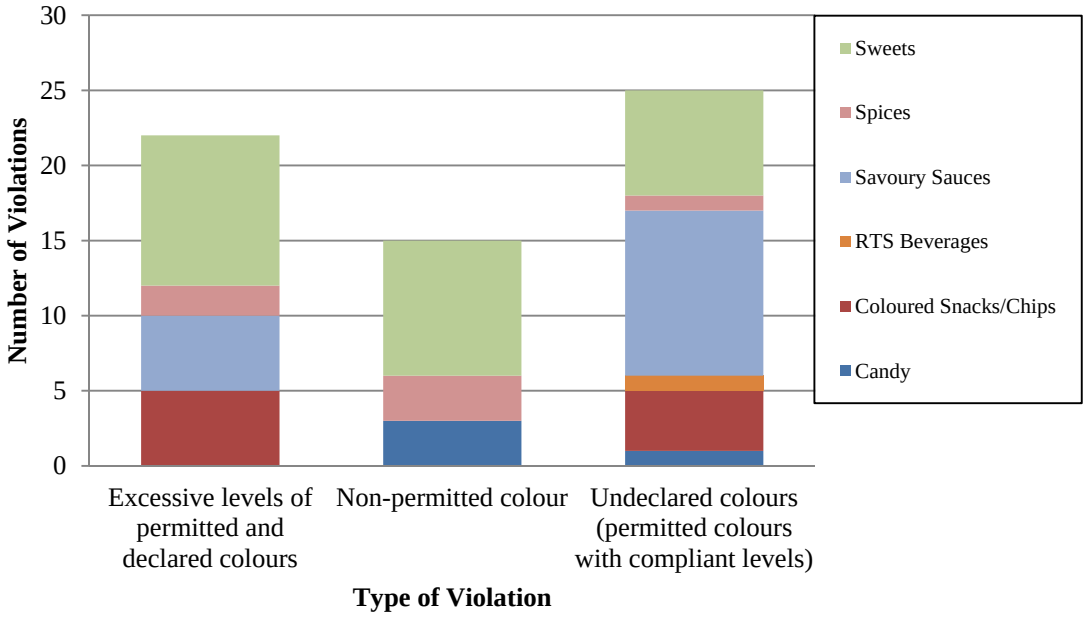

Figure 1 - Number of violations and type of violation for each product type

A total of 14 samples contained non-permitted food colours. These non-permitted food colours included Azorubine (Chromotrope FB), Patent Blue Violet Calcium, Chrysoidine G, New Coccine (Ponceau 4R), and Orange II. Eleven samples contained permitted and declared colours at levels that exceeded regulations. A total of 16 samples were found to have food colours present when no declaration of colours was made in the ingredients list. All food colour violations were evaluated and appropriate follow-up action was pursued. Exposure levels of food colour additives found in the survey were not expected to pose a human health concern to Canadian consumers. Please refer to Appendix C for a summary of food colour violations found.

3.2 Food Colour Results by Product Type

3.2.1 Candy

A total of 299 samples of candy were collected and analyzed for the 2011-2012 food colours in selected foods targeted survey. Candy samples were broken down into six types including gum, gummy candy, jelly beans, mints, suckers/lollipops and ‘other’

which included cinnamon hearts, hard candy, marshmallow candy, and licorice. The distribution of candy samples by type is shown in Table 3 (below).

Table 3 – Summary of food colour additive detections and violations distributed by type of candy

Type of Candy	Number of Samples	Number of Samples with Food Colours Not Detected	Number of Samples with Detected Food Colour (Number of Detected Food Colours)	Number of Samples in Violation (Number of Violations)
Gum	28	3	25 (44)	0 (0)
Gummy Candy	95	22	73 (257)	1 (1)
Jelly Beans	65	13	52 (245)	0 (0)
Mints	35	21	14 (30)	1 (1)
Suckers/Lollipops	51	8	43 (136)	1 (1)
Candy - Other	25	9	16 (57)	0 (0)
Total	**299**	**76**	**223 (769)**	**3 (3)**

Seventy-six of the 299 candy samples (25.4%) had no detectable food colours, 220 samples (73.6%) had compliant levels of food colour(s), and 3 samples (1.0%) were in violation of applicable Canadian food colour regulations (Figure 2).

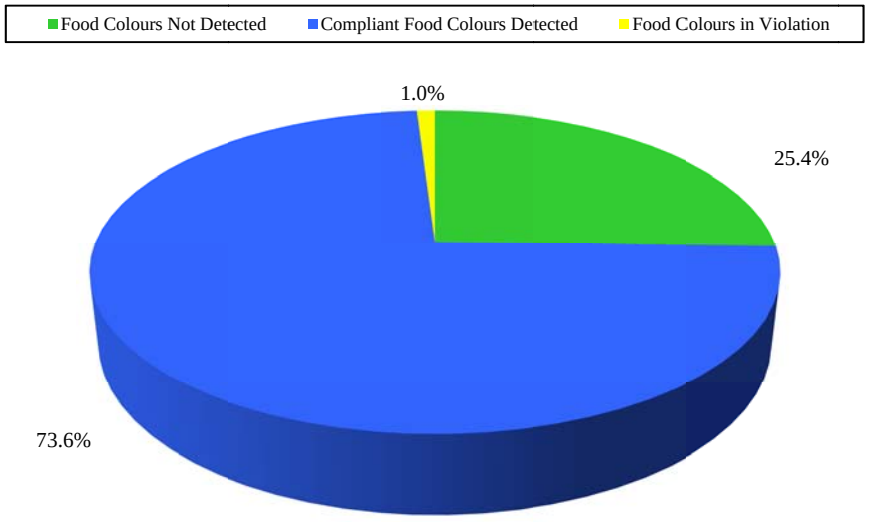

Figure 2 - Distribution of candy samples with compliant food colour additives detected, additives in violation, and food colour additives not detected

The number of synthetic food colours detected per sample is presented in Figure 3. Candy samples frequently had multiple food colours detected. Thirty-five samples were found to have one detectable food colour, 26 samples contained two detectable food colours, 33 samples contained three detectable food colours, 80 samples contained four food colours, 31 samples contained five food colours and 18 samples contained six food colours. This finding could be expected considering these product types often contain mixed flavours (gummy candy, jelly beans, suckers/lollipops) which are blended and tested as a single mixed sample and not as individual colours/flavours. The candy type with the highest percentage of detectable levels of one or more food colours was gum at 89.3%.

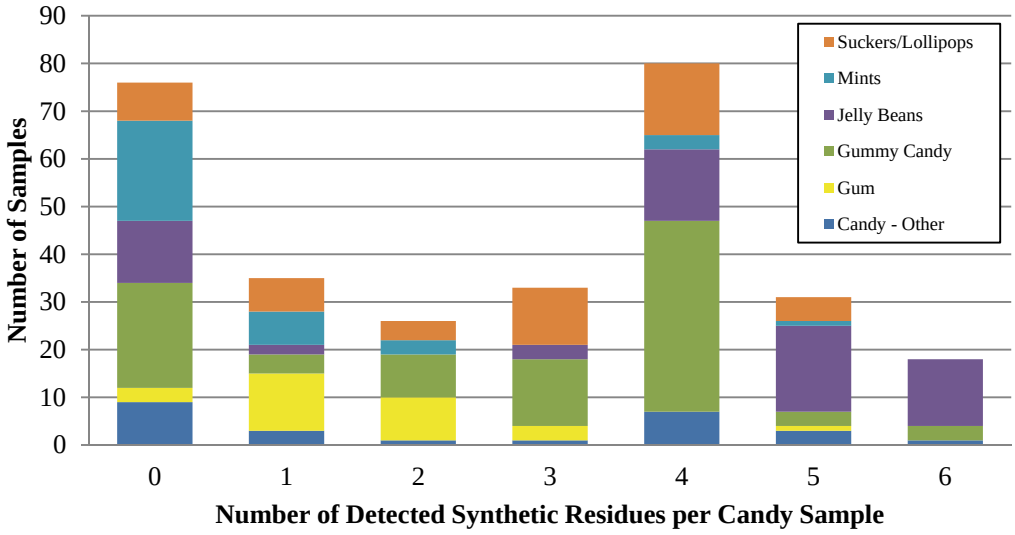

Figure 3 - Distribution of candy samples by number of detected synthetic food colours per sample

Of the product types tested, candy had the second-highest percentage of detected food colours (74.6%), second only to wasabi products (91.5%). Of the three violations observed for candy, one mint sample contained a permitted colour (Indigotine), but its use was not declared on the product label. Two samples (one sucker/lollipop and one gummy candy) were found to have very low levels of non-permitted colours, specifically New Coccine (Ponceau 4R), Azorubine (Chromotrope FB), or Patent Blue Violet Calcium. These non-permitted colours, while not permitted for use in foods sold in Canada, are permitted food additives in the EU[5,25]. All food colour violations in candy were referred to the appropriate CFIA program for follow-up actions.

3.2.2 Coloured Snacks/Chips

Forty-nine samples of coloured snacks/chips were analyzed for food colour additives. Snacks/chips samples included cheese flavoured snacks, corn chips, crackers, potato chips and 'other' (exotic vegetable chips). Table 4 outlines the distribution of coloured snacks/chips by sample type.

Table 4 – Summary of food colour additive detections and violations distributed by type of coloured snack/chip

Type of Coloured snack/chip	Number of Samples	Number of Samples with Food Colours Not Detected	Number of Samples with Detected Food Colour (Number of Detected Food Colours)	Number of Samples in Violation (Number of Violations)
Cheese flavoured snacks	15	2	13 (23)	4 (4)
Corn Chips	16	12	4 (12)	0 (0)
Crackers	12	7	5 (11)	1 (1)
Potato Chips	5	3	2 (5)	0 (0)
Coloured snacks/chips - Other	1	1	0 (0)	0 (0)
Total	**49**	**25**	**24 (51)**	**5 (5)**

Twenty-five of the 49 snacks/chips samples (51.0%) had no detectable added food colours, 19 samples (38.8%) had compliant levels of food colour(s), and 5 samples (10.2%) were found to be in violation of applicable Canadian food colour regulations (Figure 4).

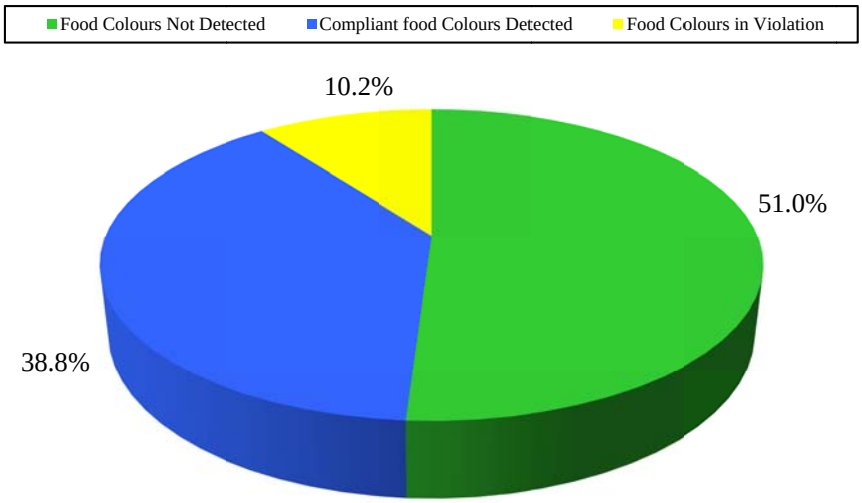

Figure 4 - Distribution of snacks/chips samples with compliant food colour additives detected, additives in violations, and additives not detected

Just over a third of the snacks/chips samples analyzed had multiple food colours detected. A summary of synthetic food colours detected per sample is presented in Figure 5. Seven samples contained one detectable food colour, 10 samples contained two detectable food colours, four samples contained three detectable food colours, and three samples contained four detectable food colours. As cheese flavoured snacks are often found to be brightly coloured, it was not unexpected to find that they were the snack/chip type with the highest percentage of detectable levels of one or more food colours (86.7%).

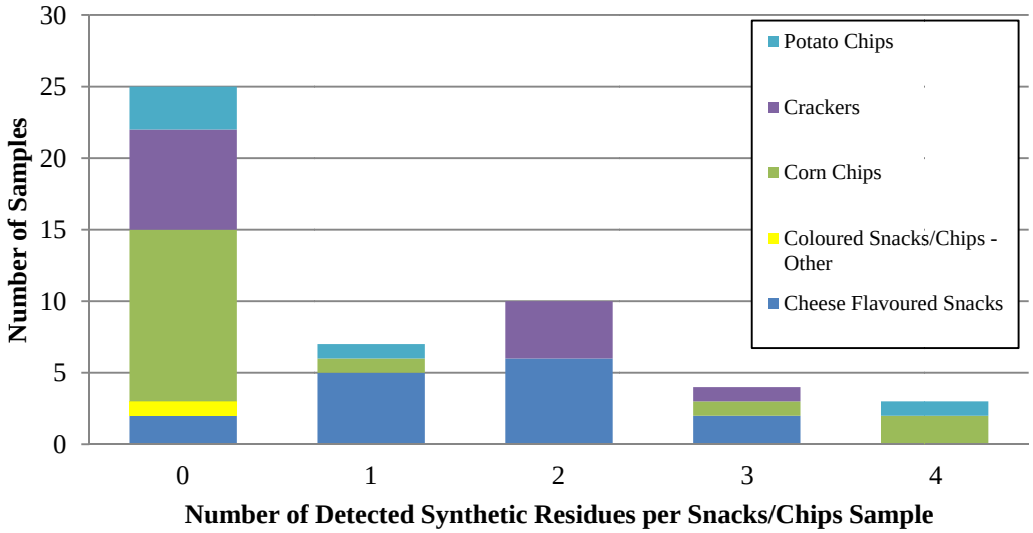

Figure 5 - Distribution of snack/chip samples by number of detected synthetic food colours per sample

Coloured snacks/chips had the highest percentage of violative samples (10.2%) of the product types tested. Of the five violations, three cheese flavoured snacks contained permitted and declared food colour(s) that exceeded the maximum level(s) of use, either singly or in combination, (in these cases one or more of Sunset Yellow FCF and Tartrazine) as per the *List of Permitted Colouring Agents*. The remaining two violative samples contained permitted food colours/levels (Sunset Yellow FCF and Tartrazine in both cases), but no declaration of use was made in the list of ingredients. All food colour violations in coloured snacks/chips were referred to the appropriate CFIA program for follow-up activities.

3.2.3 Ready-to-Serve (RTS) Beverages

Three hundred and two beverage samples were analyzed for food colours. Beverage samples included ready-to-serve drinks (fruit drinks, sports drinks, vegetable cocktails, nectars), ready-to-serve juices (fruit juices, vegetable juices), and 'other' beverages (fruit juice concentrates). The distribution of beverage samples by type is shown in Table 5. Two hundred and fifty-four of the 302 beverage samples (84.1%) had no detectable food colours, forty-seven samples (15.6%) had compliant levels of food colour(s) and one sample (0.3%) was found to be in violation of applicable Canadian food colour additive regulations.

Table 5 – Summary of food colour additive detections and violations distributed by type of ready-to-serve beverages

Type of RTS Beverage	Number of Samples	Number of Samples with Food Colours Not Detected	Number of Samples with Detected Food Colour (Number of Detected Food Colours)	Number of Samples in Violation (Number of Violations)
RTS Drinks	163	118	45 (78)	0 (0)
RTS Juices	136	133	3 (3)	1 (1)
RTS Beverage - Other	3	3	0 (0)	0 (0)
Total	**302**	**254**	**48 (81)**	**1 (1)**

The one violative sample (an imported ready-to-serve mango juice) contained a permitted level of Sunset Yellow FCF, but no declaration of colour was made in the list of ingredients.

3.2.4 Savoury Sauces

Two hundred and ninety-seven samples of savoury sauces were analyzed for food colour additives. Savoury sauce samples consisted of chili-based sauces, curry-based sauces, seafood cocktail sauces and 'other', which included barbeque, chutney, fish/oyster, hot, jerk, pasta, salsa, soy, Szechuan, teriyaki, and Thai sauces. The distribution of savoury sauce samples by type is shown in Table 6.

Table 6 – Summary of food colour additive detections and violations distributed by type of savoury sauces

Type of Savoury Sauce	Number of Samples	Number of Samples with Food Colours Not Detected	Number of Samples with Detected Food Colour (Number of Detected Food Colours)	Number of Samples in Violation (Number of Violations)
Chili-based sauces	98	88	10 (12)	3 (3)
Curry-based sauces	91	83	8 (9)	1 (1)
Seafood cocktail sauces	60	60	0 (0)	0 (0)
Sauces - Other	48	42	6 (13)	5 (5)
Total	**297**	**273**	**24 (34)**	**9 (9)**

Two hundred and seventy-three of the 297 sauce samples (91.9%) had no detectable food colours, 15 samples (5.1%) had compliant levels of food colour(s), and nine samples (3.0%) were in violation of applicable Canadian food colour additive regulations (Figure 6).

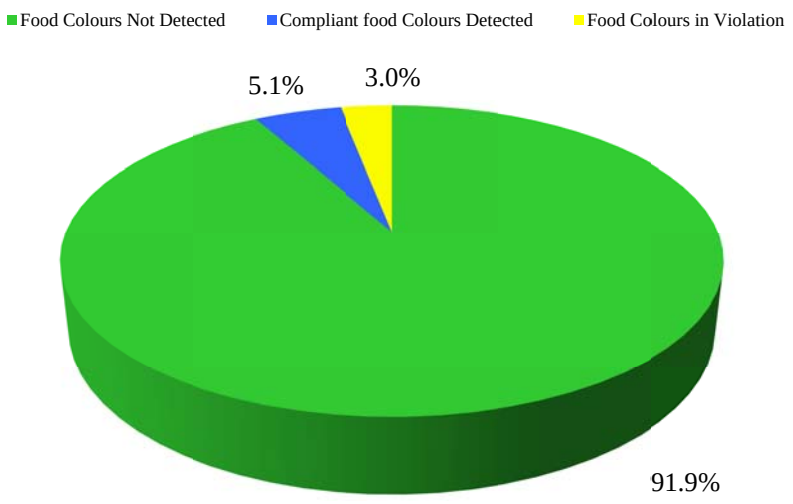

Figure 6 - Distribution of savoury sauce samples with compliant food colour additives detected, additives in violation, and food colour additives not detected

Eight samples (2.7%) of savoury sauces contained multiple synthetic food colours and seafood cocktail sauces did not contain detectable levels of synthetic food colours. Of the nine violations, seven samples (three chili-based sauces, three 'other' sauces, and one curry based sauce) contained permitted food colours/levels (one or more of Allura Red, Brilliant Blue FCF, Sunset Yellow FCF, and Tartrazine) but no declaration of colour was made in the ingredients list. Two samples (both were 'other' sauces – specifically imported banana pepper sauce) contained permitted and declared food colour(s) that exceeded the maximum level(s) of use, either singly or in combination, (one or more of Allura Red, Sunset Yellow FCF, and Tartrazine) as per the *List of Permitted Colouring Agents*. All food colour violations in savoury sauces were evaluated and appropriate follow-up action was pursued.

3.2.5 Spices

Two hundred and ninety-five samples of spices were analyzed for food colour additives. Spice samples included cayenne, chili-based seasonings, chili powder, curry, paprika, turmeric, and 'other' spices which included black pepper, chili pepper, cumin, red pepper, fennel, garlic, spice mixes, steak spice, and rubs. The distribution of spice samples by type is shown in Table 7.

Table 7 – Summary of food colour additive detections and violations distributed by type of spice

Type of Spice	Number of Samples	Number of Samples with Food Colours Not Detected	Number of Samples with Detected Food Colour (Number of Detected Food Colours)	Number of Samples in Violation (Number of Violations)
Cayenne	33	33	0 (0)	0 (0)
Chili-based seasonings	19	19	0 (0)	0 (0)
Chili powder	71	71	0 (0)	0 (0)
Curry	58	53	5 (5)	5 (6)
Paprika	62	62	0 (0)	0 (0)
Turmeric	29	29	0 (0)	0 (0)
Spices - Other	23	23	0 (0)	0 (0)
Total	**295**	**290**	**5 (5)**	**5 (6)**

Two hundred and ninety spice samples (98.3%) had no detectable food colours and five samples (1.7%) were in violation of applicable Canadian food colour regulations.

None of the spice samples had more than one food colour detected. All five violative samples were curry samples and represented six total violations. Three curry samples contained very low levels of non-permitted colours, specifically Orange II (two samples) and Chrysoidine G (one sample). One curry sample had two distinct violations: permitted colour (Tartrazine) in excess of maximum levels and permitted colour undeclared on the list of ingredients. Another curry sample was found to contain a permitted colour (Sunset Yellow FCF) in excess of the maximum levels of use as per the *List of Permitted Colouring Agents*. All food colour violations in savoury sauces were evaluated and appropriate follow-up action was pursued.

3.2.6 Sweets

Two hundred and sixty-four samples of sweets were analyzed for food colour additives. Sweets samples included cakes/mochi, cookies/wafers, dessert cups/jello/pudding, maraschino cherries and ‘other’, which included cherry pie filling, marshmallows, palm nut in syrup, and Turkish delight. The distribution of sweets samples by type is shown in Table 8.

Table 8 – Summary of food colour additive detections and violations distributed by type of sweets

Type of Sweet	Number of Samples	Number of Samples with Food Colours Not Detected	Number of Samples with Detected Food Colour (Number of Detected Food Colours)	Number of Samples in Violation (Number of Violations)
Cakes/mochi	64	37	27 (63)	7 (7)
Cookies/wafers	72	48	24 (54)	4 (5)
Dessert cups/jello/pudding	72	20	52 (110)	0 (0)
Maraschino cherries	47	3	44 (81)	5 (5)
Sweets - Other	9	3	6 (12)	0 (0)
Total	**264**	**111**	**153 (322)**	**16 (17)**

One hundred and eleven of the 264 sweets samples (42.0%) contained no detectable food colours, 137 samples (51.9%) had compliant levels of food colour(s), and 16 samples (6.1%) were in violation of applicable Canadian food colour additive regulations (Figure 7).

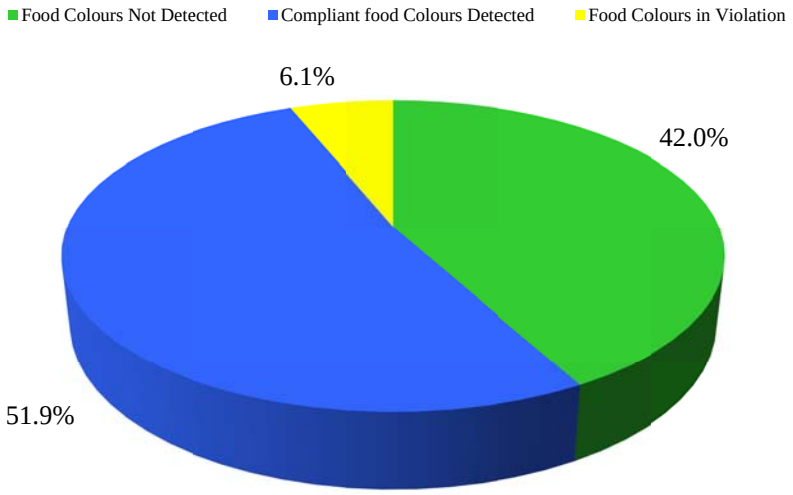

Figure 7 - Distribution of sweets samples with compliant food colour additives detected, additives in violation, and food colour additives not detected

Sweets samples frequently had multiple food colours detected. The number of detected synthetic food colours per sample is presented in Figure 8. Forty-two samples contained one detectable food colour, 68 samples contained two detectable food colours, 32

samples contained three detectable food colours, 9 samples contained four food colours, and two samples contained five detectable food colours. Maraschino cherries were the sweets sample type with the highest percentage of detectable levels of one or more food colours (93.6%).

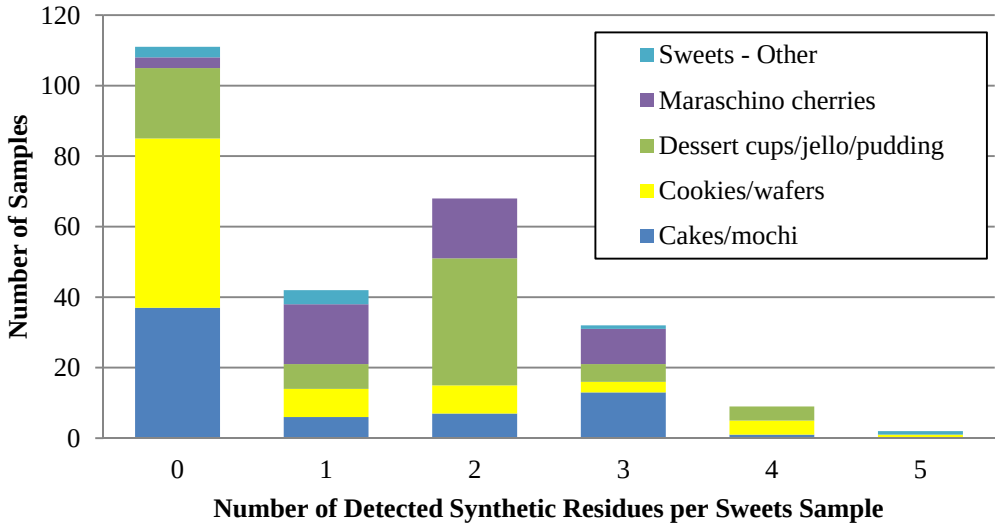

Figure 8 - Distribution of sweets samples by number of detected synthetic food colours per sample

Sweets had the second-highest percentage of violative samples (6.1%) with respect to the product types tested. Of the 16 violative samples, four samples (two maraschino cherries samples, one cakes/mochi sample, and one cookies/wafers sample) contained permitted and declared food colour(s) that exceeded the maximum level(s) of use, either singly or in combination, (one or more of Allura Red, Brilliant Blue FCF, Erythrosine B, Sunset Yellow FCF, and Tartrazine) as per the *List of Permitted Colouring Agents*. Eight samples (five cakes/mochi samples, two maraschino cherries samples, and one cookie/wafer sample) contained low levels of non-permitted colours, specifically Azorubine or New Coccine. Three samples (one cakes/mochi sample, one cookies/wafers sample, and one maraschino cherries sample) contained permitted food colours/levels (one or more of Allura Red, Brilliant Blue and Sunset Yellow FCF) but no declaration of colour was made in the ingredients list. One cookies/wafers sample had two distinct violations: the presence of a non-permitted food colour additive (Azorubine) and permitted food colours/levels (Indigotine, Sunset Yellow FCF, and Tartrazine) but no declaration of colour was made in the list of ingredients. Violations in sweets were evaluated and appropriate follow-up action was pursued.

3.2.7 Wasabi Products

Forty-seven samples of wasabi products were analyzed for food colour additives. Wasabi products consisted of wasabi paste, wasabi peas, and 'other' wasabi products including wasabi plum stir fry sauce, wasabi powder, and wasabi powdered horseradish. The distribution of wasabi product samples by type is shown in Table 9.

Table 9 – Summary of food colour additive detections and violations distributed by type of wasabi product

Type of Wasabi product	Number of Samples	Number of Samples with Food Colours Not Detected	Number of Samples with Detected Food Colour (Number of Detected Food Colours)	Number of Samples in Violation (Number of Violations)
Wasabi Paste	12	0	12 (24)	0 (0)
Wasabi Peas	32	3	29 (61)	0 (0)
Wasabi Products - Other	3	1	2 (4)	0 (0)
	47	**4**	**43 (89)**	**0 (0)**

Wasabi product samples had the highest rate of food colours detected with forty-three of 47 (91.5%) samples testing positive. No violations of applicable Canadian food colour additive regulations were found.

One interesting observation was that all forty-three samples had multiple food colours detected (two or more of Brilliant Blue FCF, Indigotine, Sunset Yellow FCF, and Tartrazine). This is not unexpected as wasabi and its products are bright green in colour and the majority of synthetic colours approved for use in Canada are generally primary in nature (red, yellow or blue).

3.2.8 Fresh Oranges

One hundred and forty-five samples of fresh oranges were analyzed for food colour additives as part of an examination of the prevalence and levels of Citrus Red 2 in oranges and orange products. Orange samples included clementines, mandarins and oranges. Only a single sample was found to contain Citrus Red 2 (0.7%). The level of Citrus Red 2 was below the 2 ppm maximum level of use stipulated in the *List of Permitted Colouring Agents*. All fresh orange samples were compliant with applicable regulations.

3.2.9 Marmalade

Fifty-two samples of orange marmalade were analyzed for food colours as part of an examination of Citrus Red 2 prevalence and levels in oranges and orange products. There were no detections of Citrus Red 2 in any of the marmalade samples analyzed. Fifty of the samples (96.2%) had no additional detectable food colours, and two samples (3.8%) contained compliant levels of food colour(s). Of these two cases, one marmalade sample was found to contain Sunset Yellow FCF while the other contained Sunset Yellow FCF and Tartrazine. All marmalade samples were found to be compliant with applicable regulations.

3.2.10 Orange Juice

Forty-nine samples of orange juice were analyzed for food colours as part of the examination of the prevalence and levels of Citrus Red 2 in oranges and orange products. Orange juice samples included orange juice from mandarins, orange juice from oranges, ready-to-serve orange drinks and ready-to-serve orange juices/blends. None of the samples were found to contain detectable levels of Citrus Red 2 and 47 of the 49 orange juice samples (95.9%) had no detectable levels of food colours. Two samples (4.1%) had compliant levels of the permitted food colours Sunset Yellow FCF and Tartrazine. All orange juice samples were compliant with applicable regulations.

3.3 Comparison to the results obtained in the 2010/11 CFIA Survey on Food Colours in Selected Foods

Overall, the compliance rate in the current targeted survey was 97.8%, compared to 96.2% in the 2010-11 FSAP Food Colours targeted survey. The previous survey (1546 samples) was slightly smaller than the current survey (1799 samples), which can be attributed to the additional commodities (fresh oranges, marmalade, and orange juice) analyzed for the presence of Citrus Red 2. The total number of samples in violation from last survey was 58 (61 violations) compared to 39 samples in the current survey (41 violations).

In general, the same types of violations found in the current survey were found in the previous survey, and both surveys had multiple samples with more than one type of violation (permitted and declared food colours were above the maximum level(s) of use and/or non-permitted colours were detected and/or permitted colours were below the maximum level(s) of use but not declared on the list of ingredients).

The number of instances non-permitted colours were detected was similar between this survey (15) and the previous survey (13), as was the number of different non-permitted food colour agents between this survey (5) and the previous survey (8). Common non-

permitted food colours between the two surveys included Azorubine (Chromotrope FB) and Chrysoidine G. The two survey years showed distinct types of non-permitted food colours. Differences in non-permitted food colours between the two surveys included Rhodamine B, Quinoline Yellow, Orange GGN, Sudan Red B, Sudan IV, and Sudan I from the last survey and New Coccine (Ponceaux 4R) and Orange II from this survey.

4. Conclusions

The main objectives of this targeted survey were to establish baseline data regarding the levels of permitted synthetic food colours in selected foods on the Canadian retail market and obtain information regarding the presence of non-permitted food colours in a variety of foods. A total of 1799 samples of both domestic and imported origin were tested for food colour additives. Overall, 97.8% of the samples were in compliance with the *Food and Drug Regulations* and associated MAs.1274 of the 1799 samples (70.8%) did not have detectable levels of food colours. When compared to the 2010-11 survey, these results show an increased rate of compliance (96.2%) and an increased rate of samples with no detectable food colours (64%). Thirty-nine of the 1799 samples (2.2%) were in violation of the aforementioned regulations, with two samples exhibiting 2 distinct violations. Most violations were attributed to permitted colours with compliant levels of use but not declared on the label. Sixteen samples fell under this category; 7 savory sauces, 4 sweets, 2 coloured snacks/chips, 1 candy and 1 spices sample. Fifteen non-permitted food colours were detected in 14 different samples (9 sweets, 3 spices and 2 candy samples). Eleven samples were in violation of excess levels of permitted and declared colours (4 sweets, 3 coloured snacks/chips, 2 savory sauces and 2 spices samples). All food colour violations were evaluated and appropriate follow-up action was pursued. Exposure to food colour additives in the samples analyzed in this survey were not expected to pose a human health concern to Canadian consumers.

The actual levels of use of food colours observed in this survey were evaluated by Health Canada’s Bureau of Chemical Safety and none of the samples were expected to pose an unacceptable human health concern. Appropriate follow-up actions were initiated that reflected the magnitude of the human health concern. No product recalls were warranted.

5. Appendices

Appendix A – List of analytes (197) targeted by the liquid chromatography and photodiode array (LC-PDA) method (Identification and quantification of aqueous (water-soluble) food colours in food products)

2,4,5-triiodofluorescein	Brilliant Crocein MOO	Methylene Blue
2,4,7-triiodofluorescein	Brilliant Yellow	Mordant Blue 9
4,4-dihydroxyazobenzene-3,3'-dicarboxylic Acid (sodium salt)	Brown Chocolate (natural)	Mordant Brown 1
4,5-diiodofluorescein	Calcomine Orange 2RS	Mordant Orange 1
4-amino-1,1'-azobenzene-3,4'-disulfonic Acid (sodium salt)	Carminic Acid	Mordant Orange 10
4-phenylazophenol (98%)	Celestine Blue	Mordant Orange 6
Acid Black 24	Chicago sky Blue 6B	Mordant Red 19
Acid Blue 113	**Chlorophyllin coppered (trisodium)**	Mordant Yellow 10
Acid Blue 120	Chrome Azurol S	Mordant Yellow 12
Acid Blue 129	Chromotrope 2R	Mordant Yellow 7
Acid Blue 161	Chromotrope FB	Naphthol Blue Black
Acid Blue 25	Chromoxane Cyanine R	Naphthol Green B
Acid Blue 29	Chrysoidine G	Naphthol Yellow S
Acid Blue 40	Chrysophenine	Napthochrome Green
Acid Blue 41	Cibacron Brilliant Red 3BA	New Coccine (Ponceau 4R)
Acid Blue 92	Cibacron Brilliant Yellow 3GP	Nitrazine Yellow
Acid Fuchsin	Citrinin	NuclearFast Red
Acid Green 25	Congo Red	Orange I
Acid Green 27	Crocein Orange G	Orange II
Acid Orange 51	Crocin	Orange G
Acid Orange 63	Crystal Ponceau 6R	Orange GGN
Acid Orange 74	Crystal Violet	Orange IV
Acid Orange 8	D & C Brown 1	Orange OT
Acid Red 1	D & C Green	Palatine Chrome Black 6BN
Acid Red 106	D & C Green 8	Palatine Fast Black wan
Acid Red 114	D & C Red 39	Palatine Fast Yellow BLN
Acid Red 151	D & C Red 8	Patent Blue VF
Acid Red 183	Direct Blue 71	Patent Blue Violet Calcium
Acid Red 33	Direct Orange 31	Phenol Red
Acid Red 37	Direct Red 23	Phloxine B
Acid Red 4	Direct Red 75	Plasmocorinth B

Acid Red 40	Direct Red 81	Polar Yellow
Acid Red 8	Direct Violet 51	Ponceau 3R
Acid Red 88	Direct Yellow 27	Ponceau 6R (Ponceau GR)
Acid Red 97	Direct Yellow 50	Ponceau S
Acid Violet 5	Direct Yellow 62	Ponceau SS
Acid Violet 7	Direct Yellow 8	**Ponceau SX**
Acid Yellow 17	Disperse Yellow 7	Primuline
Acid Yellow 25	Eosin B	Protoporphyrin IX
Acid Yellow 29	Eosin Y	Quinoline Yellow (spirit soluble)
Acid Yellow 34	Eriochrome Black T	Quinoline Yellow (water soluble)
Acid Yellow 38	Eriochrome Blue Black B	Reactive Black 5
Acid Yellow 42	**Erythrosine**	Reactive Blue 15
Acid Yellow 65	Ethyl Eosin	Reactive Blue 2
Acid Yellow 76	Fast Garnet GBC (base)	Reactive Blue 4
Acid Yellow 99	**Fast Green FCF**	Reactive Orange 16
Alizarin Blue Black B	Fast Red E (Echtrot E)	Red FB
Alizarin Red S monohydrate	Fat Brown B	Remazol Brilliant Blue R
Alizarin Violet 3R	Fat Brown RR	Rose Bengal
Alkali Blue 6B	Flavazin L	Scarlet GN
Allura Red	Flavianic Acid Hydrate	Solochrome Violet RS
Alphazurine A	Fluoresceine	Sulforhodamine B
Amaranth	Gallocyanine	Sulforhodamine G
Annatto (bixin / norbixin)	Guinea Green B	**Sunset Yellow FCF**
Auramine O	Hematoporphyrin IX	**Tartrazine**
AzoCarmine B	Hematoxylin	Thiazol Yellow G
Benzopurpurin 4B	Indigo (synthetic)	Tropalotin O
Benzyl Violet 4B	**Indigotine**	Trypan Blue
Biebrich Scarlet	Lapachol (98%)	Victoria Blue B
Bismarck Brown Y	Light Green SF Yellowish	Violamine R
Black 7984	Lissamine Green B	Violet BNP
Black BN	Methyl Eosin	Xylidine Ponceau 2R
Bordeaux R	Methyl Orange	Yellow 27175
Brilliant blue FCF (Erioglaucine)	Methyl Red (sodium salt)	Yellow RFS
Brilliant Blue G	Methyl Violet 2B	Yellow RY
Brilliant Blue R	Methyl Yellow	

Appendix B – List of analytes (19) targeted by the CFIA's liquid chromatography and photodiode array (LC-PDA) method (Method for detecting oil-dispersible food colouring agents)

Sudan I	Sudan Orange G	Metanil Yellow
Sudan II	Sudan Black B	Orange II
Sudan III	Sudan Blue II	Rhodamine B
Sudan IV	Solvent Blue 59	**Citrus Red 2**
Sudan Red B	Toluidine Red	Chlorophyllin coppered (trisodium)
Sudan Red 7B	Para Red	
Sudan Red G	Methyl Yellow	

Note: Food colours in **bold** are permitted in Canada

Appendix C – Summary of food colour violations found in the 2010-2011 Food Colours Targeted Survey

		Type of Violation					
Commodity	**Type**	**Permitted and declared colours with excessive levels**	**Non-permitted colour**	**Permitted colours with compliant levels but not declared on label**	**Number of Violations**	**Total Number of Violations**	**Total Number of Samples in Violation**
Candy	Mints			1	1		
	Suckers/Lollipops		1 - New Coccine (Ponceaux 4R), Azorubine (Chromotrope FB)		1		
	Gummy Candy		1 - Patent Blue Violet		1	3	**3**
Coloured Snacks/Chips	Crackers			1	1		
	Cheese Flavoured Snacks	3		1	4	5	**5**
Ready-to-serve beverages	RTS Drinks			1	1	1	**1**
Savoury Sauces	Chili Based Sauces			3	3		
	Sauces - Other	2		3	5		
	Curry Based Sauces			1	1	9	**9**
Spices	Curry	2	1 - Chrysoidine G 2 - Orange II	1	6	6	**5**
Sweets	Cakes/Mochi	1	5 - New Coccine (Ponceaux 4R)	1	7		
	Cookies/Waffers	1	2 - Azorubine (Chromotrope FB)	2	5		
	Maraschino Cherries	2	2 - New Coccine (Ponceaux 4R)	1	5		
						17	**16**
Total Number of Violations		**11**	**14**	**16**	**41**	**41**	**39**

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