U.S. FOOD & DRUG ADMINISTRATION

TOTAL DIET STUDY REPORT

Fiscal Years 2018-2020 Elements Data

July 2022

Table of Contents

List of Tables

List of Figures

Executive Summary

This report summarizes the analytical results for elements from the United States (US) Food and Drug Administration's (FDA) Total Diet Study (TDS) for fiscal years 2018 through 2020. The TDS is a continuous survey and one of the tools FDA uses to monitor the food supply. For the TDS, FDA collects foods from retail outlets and measures concentrations of various nutrients and contaminants in the food. The TDS was first conducted in 1961 and has been improved and expanded over the years. In 2013 the US FDA began modernizing the TDS and in fiscal year 2018, a modernized study design was implemented. Key updates to the TDS include streamlined analytical methods, a population-based sampling plan, an updated food list, and a system for relating TDS data to data from What We Eat In America (WWEIA), the food consumption portion of the National Health and Nutrition Examination Survey (NHANES). The new approach will allow for more accurate dietary exposure assessments.

The modernized TDS increased surveillance of the US food supply. For fiscal years 2018 through 2020 FDA conducted 87 food collections that resulted in a total of 3276 food samples (including foods, beverages, and water). This report provides the analytical results for elements from 3241 samples of 305 foods and beverages analyzed for 21 element analytes (68061 analytical results), as well as 35 samples of bottled water (both bottled water and bottled water specifically intended for infants) analyzed for 22 element analytes (770 analytical results). A subset of 54 samples were further analyzed for 3 arsenic species (162 arsenic speciation analytical results).

The toxic elements lead, arsenic, cadmium, and mercury were not detected (ND) in the majority of analytical results (68%):

- Lead was detected in 15% of the samples with results ranging from ND to 164 ppb (the next highest lead level detected was 63 ppb).
- Arsenic was detected in 43% of the samples with results ranging from ND to 10900 ppb (the next highest arsenic level detected was 9100 ppb). The results of the subset of samples further analyzed for inorganic arsenic ranged from 6.1 to 103 ppb (the next highest inorganic arsenic level detected was 90 ppb).
- Cadmium was detected in 61% of samples with results ranging from ND to 400 ppb (the next highest cadmium level detected was 300 ppb).
- Mercury was only detected in 8% of samples, with results ranging from ND to 250 ppb (the next highest level of mercury detected was 220 ppb).

For the TDS foods with FDA Action Levels (AL) or Standards, all results fall below the established levels/standards established by FDA:

- Action Levels: apple juice (10 ppb lead, 10 ppb inorganic arsenic), chocolate and hard candy (100 ppb lead), and infant rice cereal (100 ppb inorganic arsenic).
- Bottled water standards: 5 ppb lead, 10 ppb arsenic, 5 ppb cadmium, 2 ppb mercury.

In fiscal year 2019, additional sampling of baby foods was conducted as part of TDS. Of the 384 samples collected for this project, 65% of the associated analytical results for lead, arsenic, cadmium, and mercury had no detectable levels (and as noted above, none of the results exceeded the AL for inorganic arsenic in infant rice cereal). Bottled water intended for infants had no detectable levels of lead, arsenic, cadmium, nor mercury. The results suggest there are no significant regional or seasonal differences in analyte concentrations in foods intended for babies.

Acknowledgements

TDS Report Preparation Team:
Sarah Winfield,[1] Dana Hoffman-Pennesi,[1] Marc Boyer,[1] Judith Spungen,[1] Jeannie Vonderbrink,[2] Terry Councell,[1, 3] Edward Nyambok,[1] Alexandra Gavelek,[1] Kara Cooper,[2] and Dawn Kato[2]

Report Advisors[1]:
Mark Wirtz, Sherri Dennis, and Conrad Choiniere

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1. Food and Drug Administration (FDA), Center for Food Safety and Applied Nutrition (CFSAN), Office of Analytics and Outreach (OAO)
2. FDA, Office of Regulatory Affairs (ORA), Kansas City Laboratory (KCL)
3. TDS Coordinator, FDA/CFSAN/OAO
4. Contractor, FDA/ORA/KCL

1. Introduction

Food safety is a key public health responsibility of the United States (US) Food and Drug Administration (FDA). The FDA Total Diet Study (TDS) is one of the FDA's monitoring and surveillance tools that contribute to a safe food supply and has been conducted continuously since 1961. For the TDS, the FDA collects foods from retail outlets (such as grocery stores, warehouse stores, liquor stores and restaurants) and measures the concentrations[5] of various analytes in the collected foods. The TDS data are used to:

- Monitor the food supply and provide information on historical concentrations of nutrients and contaminants in foods,
- Evaluate trends in concentrations of nutrients and contaminants in specific foods over time,
- Estimate dietary exposure to those substances for the overall population and for selected subpopulations for specific time periods and over time, and
- Identify foods in need of more targeted sampling or monitoring.

Additionally, the samples collected through the TDS may be used as convenience samples for special testing efforts, for example FDA has analyzed multiple TDS collections for per-and polyfluoroalkyl substances (FDA, 2022a). Due to the study design and composited nature of the samples, FDA does not take regulatory actions based on TDS results. The TDS complements and informs the FDA compliance program, which is responsible for regulatory action.

Two unique aspects of the TDS are that many of the foods are prepared as they would be consumed (table-ready) prior to analysis, and in the modernized TDS, food ingredients are also collected and analyzed. Using recipes, the analyzed food ingredients can be used to calculate levels in multi-ingredient foods. The analytical results of these table-ready and ingredient foods provide the basis for estimates of the dietary intake of TDS analytes by US subpopulations.

1.1 History

The TDS has evolved over the decades of its existence. At first, all foods collected were combined to form a single composite sample, representing a total diet. Beginning in 1962, the foods were categorized into food groups to form food group composite samples that were then analyzed. In 1982, the study was modified to analyze each food individually, rather than analyzing food group composites. This approach provided, for the first time, information about analyte concentrations in specific foods, and the ability to determine contributions of each food to total dietary exposure.

5. The word "concentration" and "level" are used interchangeably in this report; an example of a concentration/level is 1 milligram (mg) of an analyte in 1 kilogram (kg) of a sample (which could be referred to as 1 mg/kg or 1 part per million, or 1 ppm). Another example is 1 microgram (µg) of an analyte in 1 kg of a sample (which could be referred to as 1 µg/kg or 1 part per billion or 1 ppb).

Historically, FDA collected samples in each of four regions (North Central, West, South and Northeast) each year for the TDS. For each regional collection, food was purchased from retail outlets in three different cities within the region. Analysts prepared the foods in the same way consumers prepare the foods at home, and combined samples to form a single composite sample for each food. Each year, different cities were selected within each region to provide greater geographic coverage in the TDS. The number of different foods sampled in the TDS increased over time and the list of foods was updated periodically to reflect changing eating patterns in the US.

TDS is a collaborative effort among FDA offices in the Washington, DC area and FDA regional and district offices and laboratories across the US. FDA's Center for Food Safety and Applied Nutrition (CFSAN) in College Park, MD provides overall management of the TDS and summarizes the analytical results. The FDA Kansas City Laboratory (KCL) in Lenexa, KS prepares and analyzes the samples for elements. The TDS relies on the FDA Office of Regulatory Affairs (ORA), which oversees district offices and laboratories across the US for providing the personnel to collect TDS samples from local retail outlets and shipping them to KCL.

1.2 Modernization

Beginning in 2013, the FDA began planning and implementing changes to the TDS to improve the data generated. TDS's updated analytical methods can detect and differentiate elements at lower levels (increased sensitivity), have improved accuracy (decreased interference from food matrices) and have increased efficiency (more analytes measured per method, so more cost effective).

FDA also changed the TDS sampling plan from convenience-based sampling (all foods collected in one of four regions at the same time each year) to population-based sampling. For population-based sampling "regional foods" are collected in six regions (approximately equal in population) twice per year to account for where people live and seasonality. Additionally, foods identified as nationally-distributed ("national foods") are collected once per year near Kansas City Laboratory. These changes have enabled FDA to collect more TDS samples and to explore whether there are regional and/or seasonal differences across analytical results.

The food lists were also updated to focus on foods that are highly consumed and foods that are used as ingredients in foods. Examples of foods added to TDS food lists include soy milk, almond milk, kale, cocoa powder, baking powder and cashews. Examples of foods dropped from the food list due to low consumption include sherbet, rye bread, and liver. For some foods, the form of the food to be analyzed changed. For example, for foods found to have greater consumption in the raw form than in the cooked form, such as spinach and cabbage, the TDS food description and form analyzed changed from "cooked" to "raw."

2. Study Design

2.1 Sample Collection

The current study design includes six regions (West, North Central, Mid-Atlantic, Northeast, Southeast, and Southwest). These regions have approximately equal population sizes, and include all 50 US states as potential sampling sites (see Figure 1). This means that Alaska and Hawaii have the potential to be chosen for TDS sampling for the first time in the history of the TDS.

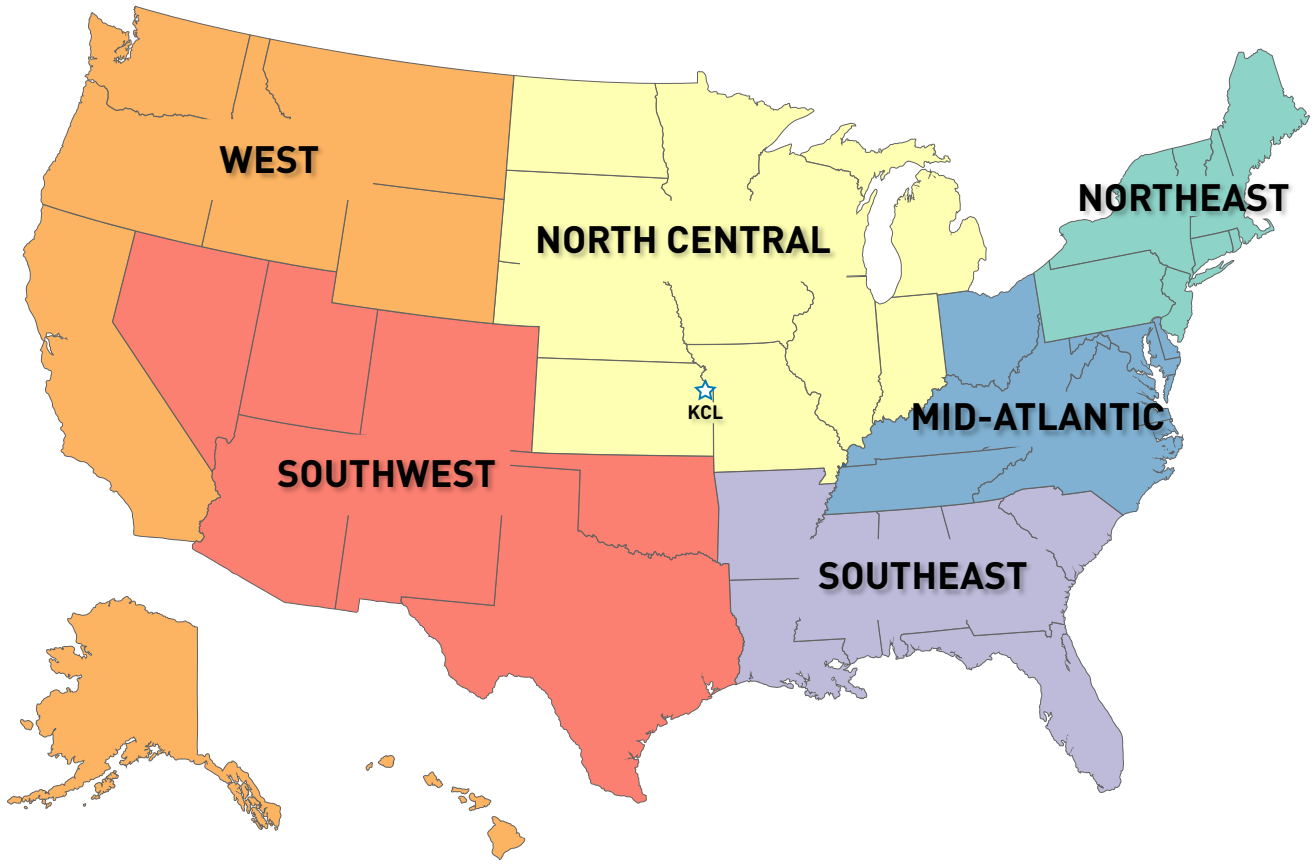

Figure 1: TDS Regions

Additionally, based on the updated sampling plan, the regional foods are collected from each region during each of two seasons. TDS seasons are six months each: the "winter" season applies to October through March collections, and the "summer" season applies to April through September collections. Over time, TDS data will provide information on potential seasonal and/or regional variation and/or trends in analyte concentrations in foods.

In the modernized TDS study design, regional foods are collected each month. Since there are six regions and two seasons, the goal is to collect from each region in the winter and summer seasons each year, as depicted in Figure 2.

Sampling Plan by Fiscal Year

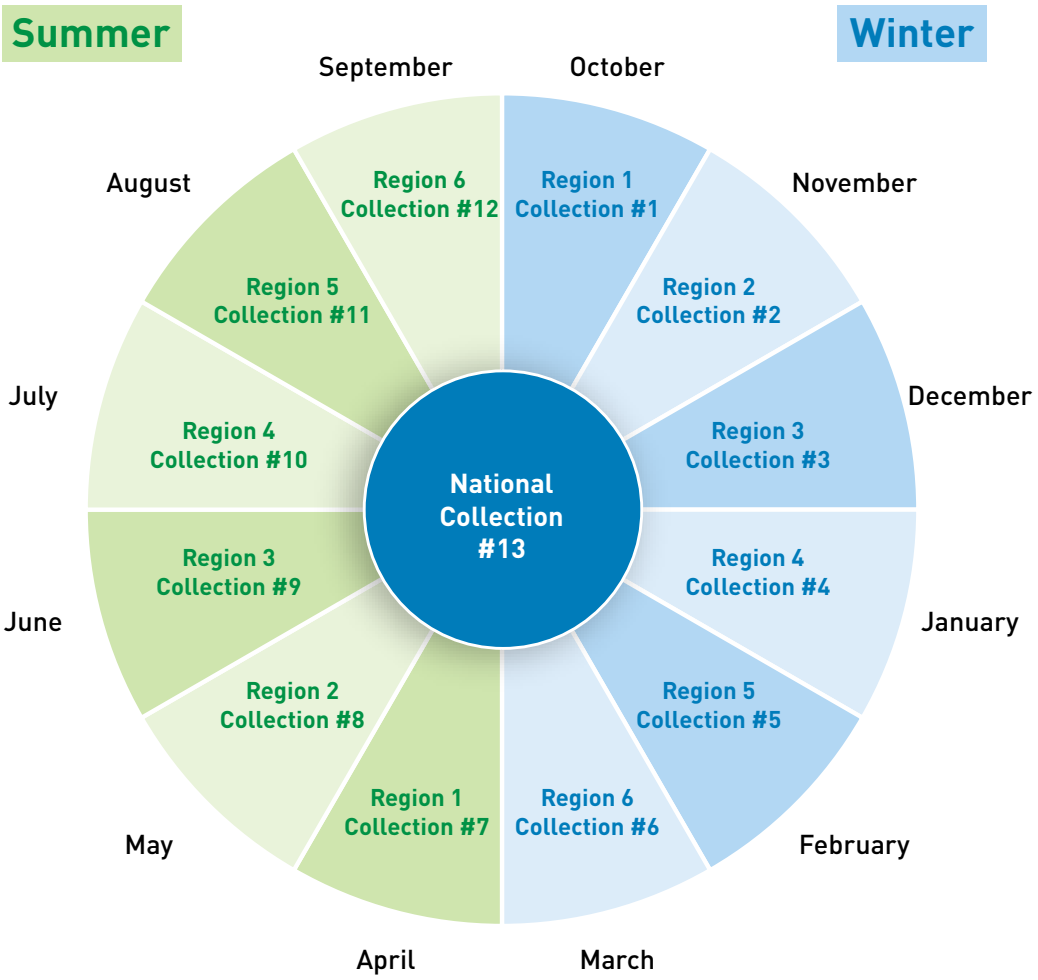

Figure 2: One year of TDS Sampling

A typical reporting cycle would include two years of sampling. However, for the fiscal years 2018-2020 TDS reporting cycle, the federal government furlough in December 2018/January 2019 and the COVID-19 pandemic in 2020 prevented collections eight times, which led to the reporting cycle including more than two years. Additional challenges were weather events, which led to some regions being sampled twice in a season, and others not being sampled during a season. Table 1 provides an overview of the regional collections for the fiscal years 2018-2020 TDS reporting cycle (also referred to as the FY2018-FY2020 TDS reporting cycle in this report). For a more detailed table that includes collection locations, and the national collections, see Appendix A, Table 6.

Table 1: Fiscal Years 2018-2020 TDS Regional Collection Overview

Collection	Month	Season	TDS Region, FY2018	TDS Region, FY2019	TDS Region, FY2020
1	October	Winter	Mid-Atlantic	West	Northeast
2	November	Winter	North Central	Southeast	Southwest
3	December	Winter	Southeast	Northeast	Mid-Atlantic
4	January	Winter	Southwest	N/A[6]	West
5	February	Winter	Southeast	N/A[6]	North Central
6	March	Winter	Northeast	Mid-Atlantic	Southeast
7	April	Summer	West	Southeast	N/A[7]
8	May	Summer	Northeast	North Central	N/A[7]
9	June	Summer	Southwest	West	N/A[7]
10	July	Summer	Mid-Atlantic	Northeast	N/A[7]
11	August	Summer	West	Mid-Atlantic	N/A[7]
12	September	Summer	North Central	Southwest	N/A[7]

For each regional collection, three cities are identified in the selected region as collection locations. The cities are chosen randomly under a plan in which more populated areas are more likely to be chosen as collection locations. Once these cities are chosen, three residential addresses are selected at random within the selected cities. After that, retail outlets (i.e., grocery stores, warehouse stores, liquor stores and restaurants) are identified that represent the most likely food shopping options near the selected residential addresses. The list of retail outlets is prioritized for FDA collectors so they can purchase the food samples efficiently. The TDS collects the same list of foods from each of the three selected cities within each region and ships the TDS collections to the Kansas City Laboratory.

2.2 Foods

Across the FY2018-FY2020 TDS reporting cycle, there were 307 foods sampled and analyzed (including foods, beverages, and water; see Appendix A, Table 5 for a complete list of these foods). For this reporting cycle,

6. N/A – Not applicable. The US federal government shutdown December 22, 2018 to January 25, 2019; during this time, many federal workers were furloughed; this period of furlough prevented the January and February 2019 collections.
7. The COVID-19 pandemic limited FDA sampling to mission critical samples only; this prevented the April through September 2020 collections.

259 of the 307 foods were collected in all 3 years and are classified as core foods; whereas other foods were deleted (7) and/or added (18).

Changes to the foods collected were made to:

- add foods that are highly consumed by the US population or subpopulations (e.g., soy milk, coconut water),
- remove foods that are not highly consumed by the US population or subpopulations (e.g., liver, sherbert),
- include foods that are ingredients in multi-ingredient foods (e.g., chicken broth, sea salt, iodized salt, baking powder), and
- allow for continuity and trend analyses across TDS reporting cycles (i.e., approximately 70% of foods were continued from 2017 into this reporting cycle).

Approximately 70% of the foods in the FY2018-FY2020 remained the same as those collected prior to this reporting cycle. The information sources that informed decisions about what foods were added, removed and retained include:

- What We Eat in America (WWEIA), the dietary interview portion of the US Centers for Disease Control and Prevention's National Health and Nutrition Examination Survey (NHANES),
- the Environmental Protection Agency's (EPA's) Food Commodity Intake Database (FCID), and
- TDS analyte trends from past reporting cycles.

The foods were then collected according to the list the food was on:

- Regional Food List: includes foods likely to have analyte concentrations that vary by location or by time of year and are collected once a month.
- National Food List: includes foods not likely to have analyte concentrations that vary by location or by time of year and are collected once a year.
- Additional Food List: includes foods that are part of a project to obtain additional information about a particular type of food. For example, additional baby foods were collected in FY2019 as part of regional collections 2, 6, 8, 10 and 12 (see Appendix A, Table 6 for additional information about these collections).

Table 2 groups foods into categories to provide an overview of the breadth of foods collected as part of the TDS.

Table 2: Types and Examples of TDS Foods

Food Type	Number of Foods	Examples
Alcohol	5	Beer, Whiskey/Scotch, Red wine, White wine
Baby Food (BF)	62	BF peaches, BF apples, BF macaroni and cheese with vegetables, BF turkey and rice
Bakery	14	Blueberry muffin, Pumpkin pie, Sugar cookies, Doughnut
Beverages	15	Tea, Coffee, Coconut water, Energy drink
Candy/Sweets	7	Chocolate bar, Fruit snack candies, Fruit-flavored popsicle, Hard candy
Condiments/Sauces	17	Ketchup, Chocolate syrup, Ranch dressing, Soy sauce
Dairy	22	Whole milk, Butter, Cottage cheese, Yogurt
Fruit	24	Apples, Bananas, Cantaloupe, Mango
Grains	35	Rice, Oatmeal, Saltine crackers, Corn tortillas
Ingredient	10	Sugar, Olive oil, Breadcrumbs, Chicken broth
Meat	16	Ground beef, Turkey breast, Frankfurter, Bacon
Mixture	13	Cream of mushroom soup, Chili con carne with beans, Pork and beans, Macaroni and cheese
Nuts/Seeds	5	Peanuts, Sunflower seeds, Walnuts, Almonds
Restaurant-food	7	Chicken nuggets, French fries, Vanilla milk share, Pizza
Seafood	7	Fish sticks, Salmon, Canned tuna, Tilapia
Vegetable	46	Cauliflower, Mushrooms, Garlic, Chickpeas
Water	2	Bottled water, BF water

2.3 Sample Preparation

To ensure there is enough of each sampled food for analysis, a substantial amount of each food is collected. For example, the Kansas City Laboratory (KCL) receives 6 medium pizzas every regional collection and 8 cans of chickpeas for the national collection. A regional collection weighs over 1000 lbs., and a national collection over 800 lbs. (see Appendix A, Table 5 for more information about amounts collected).

After food samples are received at KCL, they are unpackaged and inspected. Many foods are prepared and cooked in the same ways consumers prepare their food. For example, bananas are peeled, meats are cooked, eggs are hard-boiled and then peeled, and brownies are made from a box mix. For foods prepared with water, such as condensed soups, deionized water is used (see Appendix A, Table 5 for more information about how each food is prepared). Following any necessary cooking steps, foods are then prepared for analysis by homogenizing the food. Homogenization methods vary depending on the food. For example, juices and baby foods are mixed in a bowl with a spoon, whereas cheese and meat are blended in an industrial food processor (knife mill). For regional foods, equal portions of these foods from each collection city are combined to form the composite sample. Figure 3 below depicts how samples are collected and prepared.

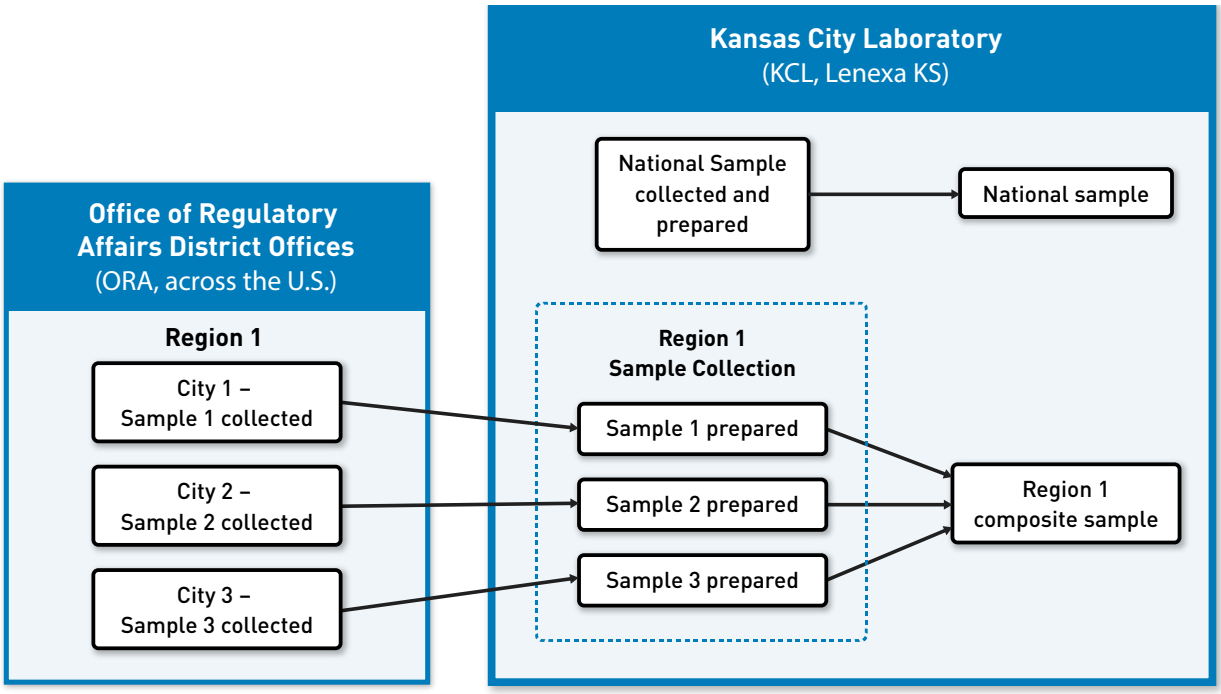

Figure 3: TDS Sample Collection and Preparation

3. Analytical Methods

After foods are prepared and combined into composite samples, they are digested and analyzed using the methods described in the FDA Elemental Analysis Manual (EAM) for Food and Related Products (FDA, 2022b). Across all foods (which include foods, beverages, and water) samples are analyzed for 25 element analytes. However, analytical methods and analytes differ for TDS food/beverage matrices and water matrices. The analytical methods used to analyze food/beverage matrices are Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) referenced in EAM 4.12. Although the analytical methods used to analyze water matrices are also ICP-AES and ICP-MS, the analytes and instruments are different (referenced in EAM 4.4). Additional information on these analytical methods is provided in Appendix B, Tables 7 and 8.

The difference in analytes analyzed for in foods/beverages versus water matrices is based on the chemical properties of analytes and historical information for each analyte – whether the analytes can exist and/or be efficiently analyzed in the matrix and/or whether the analyte has been found in the matrix. Figure 4 shows the 18 elements analyzed for in all foods (the intersection of the two circles), the 21 elements analyzed for in foods/beverages (left circle), and the 22 elements analyzed for in water (right circle). The additional four elements analyzed for in water only (far right side of right circle) are elements identified in the bottled water regulations, 21 CFR 165.110.

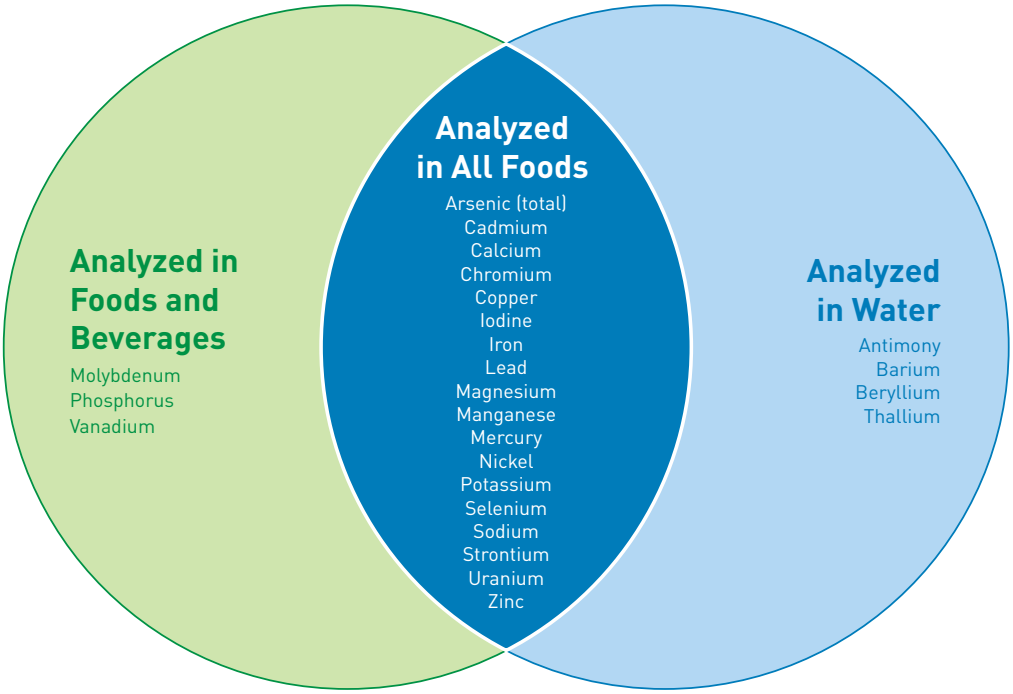

Figure 4: Elements Analyzed for in Food, Beverage, and Water Matrices

Furthermore, certain food samples (i.e., rice-containing foods, juice, and wine) that exceeded a specified level of total arsenic (e.g., 10 ppb for juice) were analyzed further to speciate the arsenic, using the analytical method High Performance Liquid Chromatography-Inductively Coupled Plasma-Mass Spectrometry (HPLC-ICP-MS). Additional information on the arsenic speciation analytical methods is provided in Appendix B, Table 9, and additional information on the select foods and total arsenic levels that result in arsenic speciation is provided in Appendix B, Table 10.

All element analytes are analyzed for "total" amount of that analyte (e.g., whether mercury is bound to other elements is not a consideration, the analytical method determines the concentration of mercury in the sample). Even though all element analytes are analyzed for "total," only arsenic is described as "total arsenic," because this is the only analyte in the TDS further analyzed for specific forms of the analyte.

While TDS analytical methods are sensitive, they do not confirm the complete absence of an analyte. Analyte concentrations below reporting limits are described as "not detected" or "non-detects" (ND) in this report

(versus detectable levels or "detects" or "D"). The reporting limits are administrative limits, based on limit of detection (LOD) and limit of quantification (LOQ) values across analyses.

4. Analytical Results

For the FY2018-FY2020 reporting cycle, 307 foods (including foods, beverages, and water) were sampled up to 27 times each, resulting in a total of 3276 composite food samples. These samples were analyzed for 25 elements (excluding arsenic speciation, which included 3 additional analytes), resulting in 68831 analytical results for elements (and an additional 162 arsenic speciation analytical results).

FDA conducted arsenic speciation for some samples based on the food as well as the level of total arsenic found in the sample. The samples considered for arsenic speciation are foods that are commonly eaten and where the total arsenic concentrations tend to be higher than other foods (FDA, 2016). The foods selected for arsenic speciation were rice-containing foods, juices, and wine.[8] FDA conducts arsenic speciation analyses because current research indicates exposure to inorganic arsenic is associated with more severe health effects than exposure to organic arsenic, although the toxicity of organic arsenic is an emerging area of science (FDA, 2020b).[9] Additional information on the select foods and total arsenic levels that result in arsenic speciation is provided in Appendix B, Table 10.

4.1 Data Characterization and Summary by Analyte

Table 3 summarizes the analytical results for elements in foods, which are analyzed for 25 element analytes (and some samples are further analyzed to speciate the total arsenic). Looking across the mean concentrations for all foods, the five foods with the highest mean concentration (using all analyzed samples for that food) are listed in descending order.[10] For a summary of analytical findings for each food, see the TDS website (FDA, 2022c), where the summary is available to download.

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8. One constraint on what foods are selected for arsenic speciation is whether an analytical method exists for that food matrix. Fish and seafood are types of food that tend to have total arsenic levels higher than other foods, however, the analytical methods used for the FY2018-FY2020 TDS data were not capable of speciating arsenic in fish and seafood.
9. Total arsenic contains both inorganic and organic arsenic species (or compounds). Organic arsenic compounds contain the element carbon in addition to arsenic. Inorganic arsenic compounds contain a non-carbon element, such as oxygen, in addition to arsenic (FDA, 2020b).
10. For analytes only analyzed for in water (antimony, barium, beryllium, and thallium) there are up to two foods that can be listed (bottled water and baby food water).

Table 3: Summary of Analytical Results for Elements

Analytes[11]	% Not Detected	Foods with Highest Mean Concentrations[12]
Antimony[13]	26%	Bottled water
Arsenic (total)[14]	57%	Baked cod; Canned tuna; Fish sticks; Baked salmon; Pre-cooked shrimp
Arsenic (inorganic)[14]	0%	Crisped rice cereal; BF rice cereal (dry); White rice; BF puffed snacks; BF mixed cereal (multi-grain)
Barium[13]	23%	Bottled water
Beryllium[13]	97%	Bottled water
Cadmium	39%	Sunflower seeds; Spinach; Potato chips; Leaf lettuce; French fries
Calcium	1%	American cheese; BF teething biscuits; BF mixed cereal (multi-grain); Swiss cheese; Cheddar cheese
Chromium	87%	Chocolate-flavored syrup; Sandwich cookies; Milk chocolate candy bar; BF sweet potato, apple & spinach pouch; American cheese
Copper	19%	Sunflower seeds; Walnuts; Almonds; Infant formula (milk-based, dry); Peanuts
Iodine	41%	Hamburger/hotdog buns (white); White bread (enriched, pre-sliced); Fruit-flavored popsicle; Baked cod; Swiss cheese
Iron	9%	BF rice cereal (dry); BF mixed cereal (multi-grain); BF oatmeal cereal; Oat ring cereal; Crisped rice cereal
Lead	86%	BF sweet potatoes; BF teething biscuits; Sandwich cookies; White wine; Ranch salad dressing (low-calorie)
Magnesium	1%	Sunflower seeds; Almonds; Peanuts; Peanut butter; Walnuts
Manganese	13%	BF oatmeal cereal; BF mixed cereal (multi-grain); Oat ring cereal; Sunflower seeds; Walnuts
Mercury	93%	Canned tuna; Baked cod; Baked salmon; Pan-cooked catfish; Pre-cooked shrimp

11. 18 analytes were analyzed for in all 3276 samples; four analytes (antimony, barium, beryllium and thallium) were only analyzed in water (35 samples) and three analytes (molybdenum, phosphorus, and vanadium) were not analyzed for in water (3241 samples). Inorganic arsenic was analyzed for in a subset of samples (see footnote c).
12. The five foods with the highest mean concentration are listed for each analyte, except for analytes only analyzed for in water (where up to two foods can be listed). Non-detects were included as zeros when calculating means. Foods with only one sample of the food during the FY2018-FY2020 reporting cycle were excluded from selection.
13. Antimony, barium, beryllium, and thallium are only analyzed for in water; all were found in bottled water, only thallium was found in BF water (bottled water intended for infants).
14. Total arsenic contains both inorganic and organic arsenic species. 54 samples where total arsenic exceeded a specified level were speciated, including white rice, crisped rice cereal, grape juice, white wine, and the following BFs: teething biscuits, rice cereal (dry and prepared), mixed cereal (multi-grain), grape juice and puffed snacks (TDS does not currently speciate fish and seafood samples); inorganic arsenic is reported in this table, for information on the two other arsenic speciation analytes (dimethylarsinic acid, DMA and monomethylarsonic acid, MMA) see the summary of analytical findings, available to download from the TDS website (FDA, 2022c). See Appendix B, Table 10 for additional information.

BF: Baby Food

Analytes[11]	% Not Detected	Foods with Highest Mean Concentrations[12]
Molybdenum	45%	Oat ring cereal; BF oatmeal cereal; Protein powder; Chickpeas; Soy milk
Nickel	55%	Sunflower seeds; Walnuts; Oat ring cereal; BF oatmeal cereal; Honey oat ring cereal
Phosphorus	1%	American cheese; Sunflower seeds; Swiss cheese; Biscuits; BF oatmeal cereal
Potassium	1%	Potato chips; Raisins; Protein powder; Infant formula (milk-based, dry); Sunflower seeds
Selenium	41%	Canned tuna; Sunflower seeds; Protein powder; Oven-cooked bacon; Pan-cooked pork chop
Sodium	16%	Soy sauce; Salami; Oven-cooked bacon; Pretzels; American cheese
Strontium	12%	Dill pickles; Olives; Almonds; Protein powder; Pan-cooked kale
Thallium[13]	80%	Bottled water; BF water
Uranium	75%	American cheese; BF teething biscuits; BF mixed cereal (multi-grain); BF oatmeal cereal; Honey oat ring cereal
Vanadium	84%	American cheese; Red wine; White wine; Hard candy; Chocolate chip cookies
Zinc	4%	Oat ring cereal; Honey oat ring cereal; BF teething biscuits; BF mixed cereal (multi-grain); BF oatmeal cereal

11. 18 analytes were analyzed for in all 3276 samples; four analytes (antimony, barium, beryllium and thallium) were only analyzed in water (35 samples) and three analytes (molybdenum, phosphorus, and vanadium) were not analyzed for in water (3241 samples). Inorganic arsenic was analyzed for in a subset of samples (see footnote c).
12. The five foods with the highest mean concentration are listed for each analyte, except for analytes only analyzed for in water (where up to two foods can be listed). Non-detects were included as zeros when calculating means. Foods with only one sample of the food during the FY2018-FY2020 reporting cycle were excluded from selection.
13. Antimony, barium, beryllium, and thallium are only analyzed for in water; all were found in bottled water, only thallium was found in BF water (bottled water intended for infants).

BF: Baby Food

4.1.1 Selected Nutrient Elements

Calcium, iodine, iron, and potassium are considered nutrients of public health interest because inadequate intakes of these nutrients can impact health (USDA, 2020). This section summarizes the foods with the highest mean concentrations of these nutrients. Some foods are fortified, and high mean concentrations may be due to fortification or use of additives (e.g., iodine-containing dough conditioners used in bread), while high mean concentrations in other foods are naturally occurring (e.g., calcium in milk, and iron in ground beef and beef steak).

For the FY2018-FY2020 TDS data reporting cycle, the foods with the highest mean concentration of calcium were American cheese, baby food teething biscuits and baby food mixed cereal (multi-grain). Cheeses other

than American cheese (e.g., cheddar, Monterey, mozzarella, Swiss), ready-to-eat cereals (e.g., oat ring cereal), protein powder, and almonds were also high in calcium.

The foods with the highest mean concentration of potassium were potato chips, raisins, and protein powder. Additionally, nuts (peanuts, peanut butter, cashews [only one sample] and almonds), sunflower seeds, infant formula and ready-to-eat cereals were also high in potassium.

Not surprisingly, the food with the highest iodine concentration was iodized salt (only one sample). High mean concentrations of iodine were found in hamburger/hotdog buns (white), white bread (enriched, pre-sliced) and whole wheat bread (pre-sliced), likely due to presence of iodine-containing dough conditioners in some samples of these products. Figure 5 shows the ranges of iodine in these TDS breads (the box and whisker chart shows the minimum, median and maximum iodine concentrations), and the wide ranges of concentrations likely reflect the presence of iodine containing ingredients (e.g., iodine-containing dough conditioners) in some samples versus other samples not containing these ingredients.

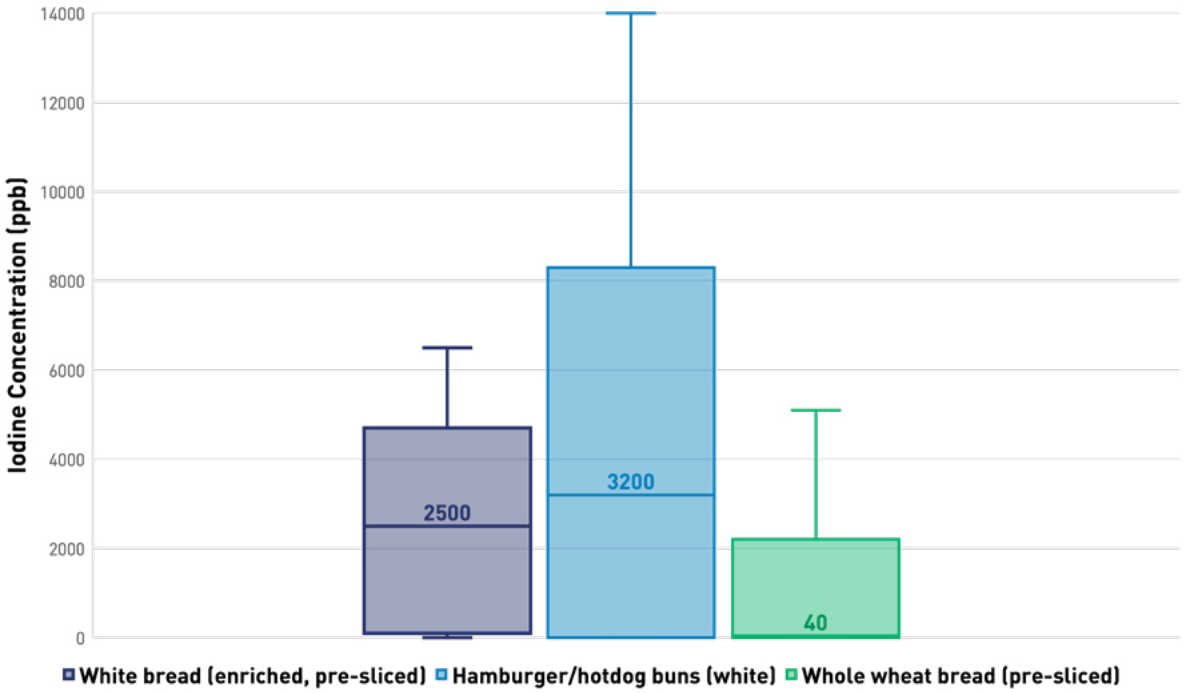

Figure 5: Iodine Concentration Ranges in TDS Breads with High Mean Concentrations of Iodine

Fruit-flavored popsicles contained relatively high mean iodine concentrations, possibly due to use of FD&C Red 3, a food dye that contains iodine. Other high mean iodine concentrations were found in cheeses, infant formulas, fish (baked cod and fish sticks), protein powder and eggs. High mean iodine concentrations in these foods may reflect fortification, the use of feed additives, residues from iodine-containing cleaning agents, or iodine naturally present in food (Ershow et. al., 2018; USDA, FDA and ODS-NIH, 2022).

For the FY2018-FY2020 TDS data reporting cycle, the foods with the highest mean concentrations of iron are baby food cereals (rice, mixed [multi-grain] and oatmeal), ready-to-eat cereals, and infant formula. The iron in these foods is most likely from fortification.

4.1.2 Selected Toxic Elements

Arsenic, cadmium, lead, and mercury are priorities of the FDA's Closer to Zero Action Plan (FDA, 2022d), as high levels of exposure over time to these elements may have adverse health impacts.

Total arsenic concentrations are measured in all foods. In addition, arsenic speciation is performed to determine concentrations of inorganic arsenic in select foods. In speciated samples, the highest mean inorganic arsenic concentration was 93 ppb in crisped rice cereal (three of three crisped rice cereals were speciated, ranging from 8.9 to 103 ppb inorganic arsenic). The food with the highest number of speciated samples was infant rice cereal, and all inorganic arsenic concentrations in infant rice cereal were below the 100 ppb action level established by FDA (FDA, 2020a). Additionally, none of the apple juice samples exceeded 10 ppb total arsenic, which is the level above which the sample would be speciated (and 10 ppb inorganic arsenic is the action level in FDA's draft guidance for industry for inorganic arsenic in apple juice [FDA, 2013]).

The foods with the highest mean total arsenic concentrations were seafoods including baked cod, canned tuna, and fish sticks. Studies suggest that fish and seafood have high levels of organic arsenic species (Rattanachongkiat et. al., 2004; Richter et. al., 2012; Mania et. al., 2015). Other than seafoods, crisped rice cereal, baby food rice cereal, and brown and white rice also had high mean total arsenic concentrations.

The highest cadmium concentrations were found in spinach, sunflower seeds, and cocoa powder (only one sample), respectively. The foods with the highest mean cadmium concentrations are sunflower seeds and spinach, two foods that typically have elevated levels of cadmium; likely due to cadmium in the soil where growing occurs, the nature of the foods, as well as cultivating practices (ATSDR, 2012; Schaefer et. al., 2020). The next highest mean cadmium concentration was found in potato chips. The TDS data are consistent with other reports that found, after leafy greens (e.g., spinach), potatoes and other root vegetables typically have higher levels of cadmium than other foods, such as grain crops (ATSDR, 2012).

The highest lead concentrations were in baking powder and cocoa powder; but as these foods were added to the National Food List in FY2020, there is only one sample representing each food, and results may not be representative and indicate a need for further testing. The foods with the highest mean lead concentrations were baby food sweet potatoes, baby food teething biscuits, and sandwich cookies. Like cadmium, lead is found in soil and may get into food through uptake from contaminated soil (Abt et. al., 2018; ATSDR, 2020). The sandwich cookies have cocoa powder as an ingredient and that might explain the source of the lead, as cocoa powder can contain higher levels of lead than other foods and ingredients (Abt et. al., 2018). FDA has set an action level for lead in chocolate and sugar-based candy at 100 ppb (0.1 ppm, FDA, 2006); all TDS chocolate and sugar-based candy samples were below the 100 ppb action level (the maximum concentration detected was 8.3 ppb, 6 out of 9 results did not have detectable levels).

Mercury was not detected (ND) in the majority of samples (93% ND, 245 detects out of 3276 analyzed samples). Only 33 of the 307 foods analyzed for mercury had detectable levels. The highest mean mercury concentrations were in fish samples. Canned tuna, baked cod, and baked salmon had mean concentrations of 230 ppb, 83 ppb, and 21 ppb, respectively. Of the 33 foods with detectable results, 28 had mean mercury

concentrations less than 10 ppb, and all detectable mercury (total mercury) results (mostly seafood) were below the 1 ppm (1000 ppb) action level for methyl mercury established for fish, shellfish, crustaceans, and other aquatic animals per Compliance Policy Guide (CPG) Sec. 540.600 (FDA, 2007).

4.2 Data Characterization and Summary for Selected Food Groups

The following sections summarize selected nutrient and toxic elements in selected groups of foods. For a summary of analytical findings for each food, see the TDS website (FDA, 2022c), where the summary is available to download.

4.2.1 Nutrient Elements in Selected Food Groups

In this section foods that are vegetables, fruits and dairy are grouped, and then selected nutrient element analytes are summarized across foods in these groups (see Figures, 6 to 8).

Vegetables

Calcium and potassium were detected in every vegetable sample, and iron in nearly every sample (715 out of 719 samples, or 99%), while iodine was detected in about half of the samples (mean concentrations in vegetables ranged from: calcium, 8.7–3100 ppm; iodine, ND–640 ppb; iron ND–32000 ppb; potassium, 570–6700 ppm).

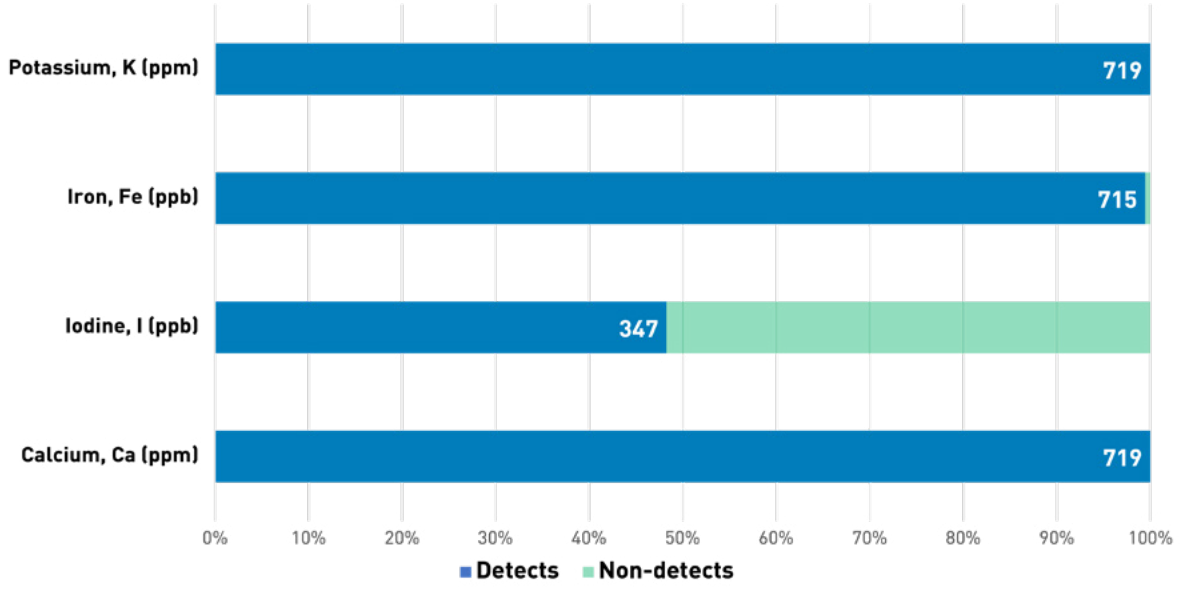

Figure 6: Selected Nutrient Elements, Percent Detects/Non-detects in Vegetables

Fruits

Calcium, iron, and potassium were detected in over 90% of fruit samples, whereas iodine was detected in about 40% of samples (mean concentrations in fruits ranged from: calcium, ND–560 ppm; iodine, ND–460 ppb; iron, ND–26000 ppb; potassium, 590–9200 ppm).

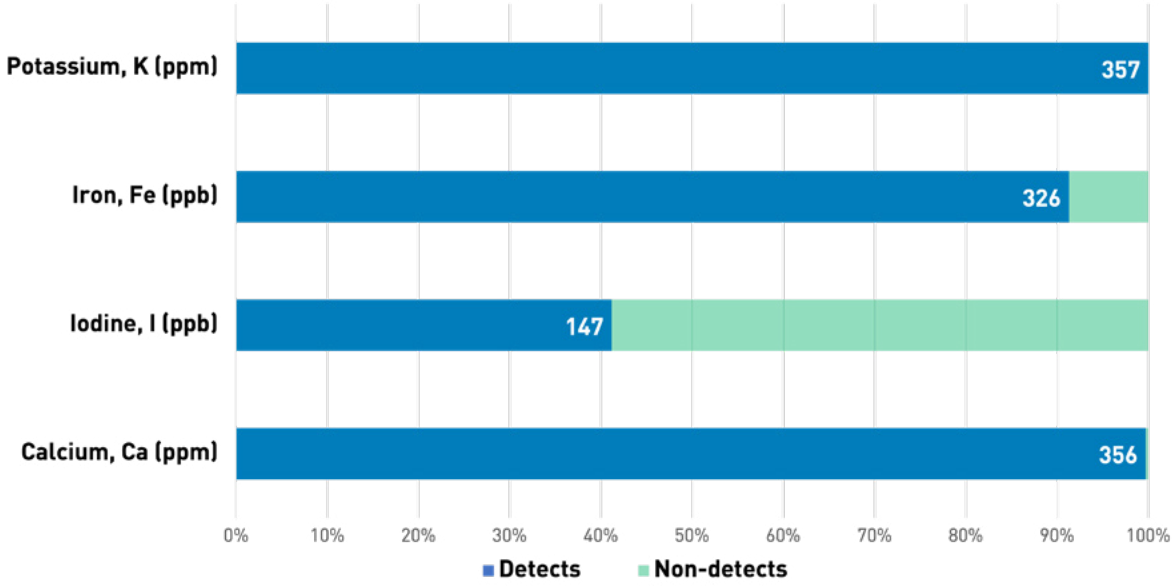

Figure 7: Selected Nutrient Elements, Percent Detects/Non-detects in Fruits

Dairy

The nutrient elements calcium, iodine, and potassium were detected in every dairy food sample (mean concentrations in dairy foods ranged from: calcium, 620–18500 ppm; iodine, 130–4400 ppb; potassium, 640–3100 ppm), whereas iron was detected in about half of samples (mean concentrations of iron in dairy foods ranged from ND–13000 ppb).

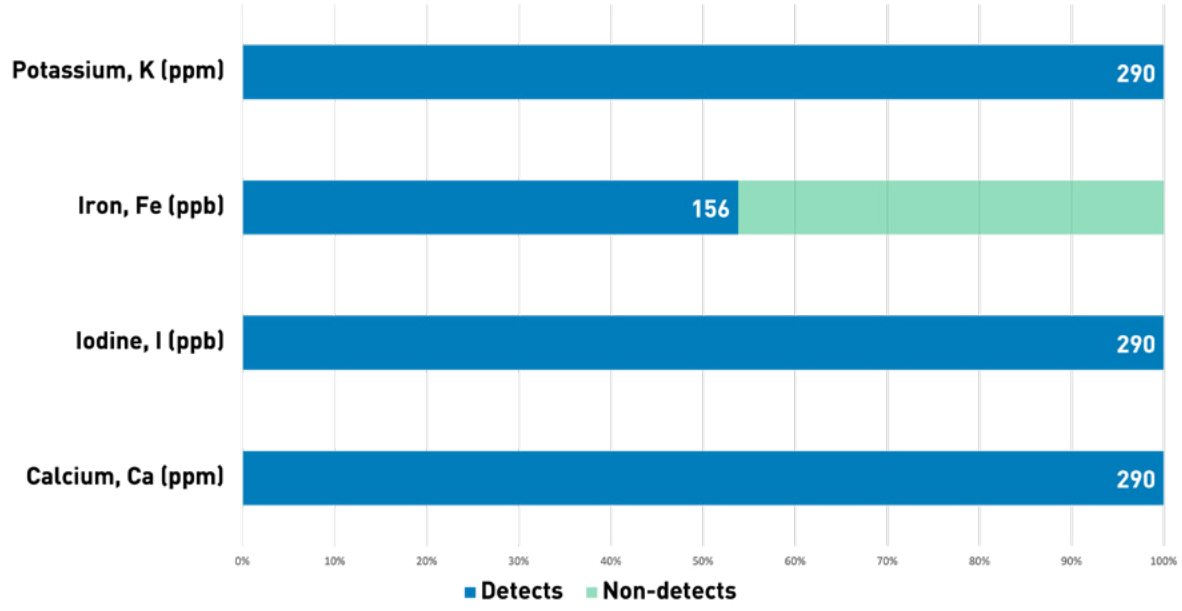

Figure 8: Selected Nutrient Elements, Percent Detects/Non-detects in Dairy

4.2.2Toxic Elements in Selected Food Groups

In this section, the toxic element analytes total arsenic, cadmium, lead, and mercury are looked at across foods that are vegetables, fruits, and dairy (see Figures 9 to 13). Total arsenic, lead, and mercury were not detected in the majority of vegetable, fruit and dairy samples; however, as expected, cadmium was detected in the majority of vegetables (ATSDR, 2012; Schaefer et. al., 2020).

Vegetables

Total arsenic, lead, and mercury were detected in less than half of the FY2018-FY2020 vegetable samples (35%, 10%, and 6% detects respectively); whereas cadmium was detected in 93% of vegetable samples (mean concentrations in vegetables range from: total arsenic, ND – 15 ppb; cadmium, ND–222 ppb; lead, ND–12 ppb; mercury, ND – 1.8 ppb). Certain vegetable foods, such as leafy greens and potatoes, are known to have concentrations of cadmium (ATSDR, 2012), and for non-smokers, dietary exposure (mostly through fruits and vegetables) is the primary source of cadmium exposure (ATSDR, 2012; Schaefer et. al., 2020).

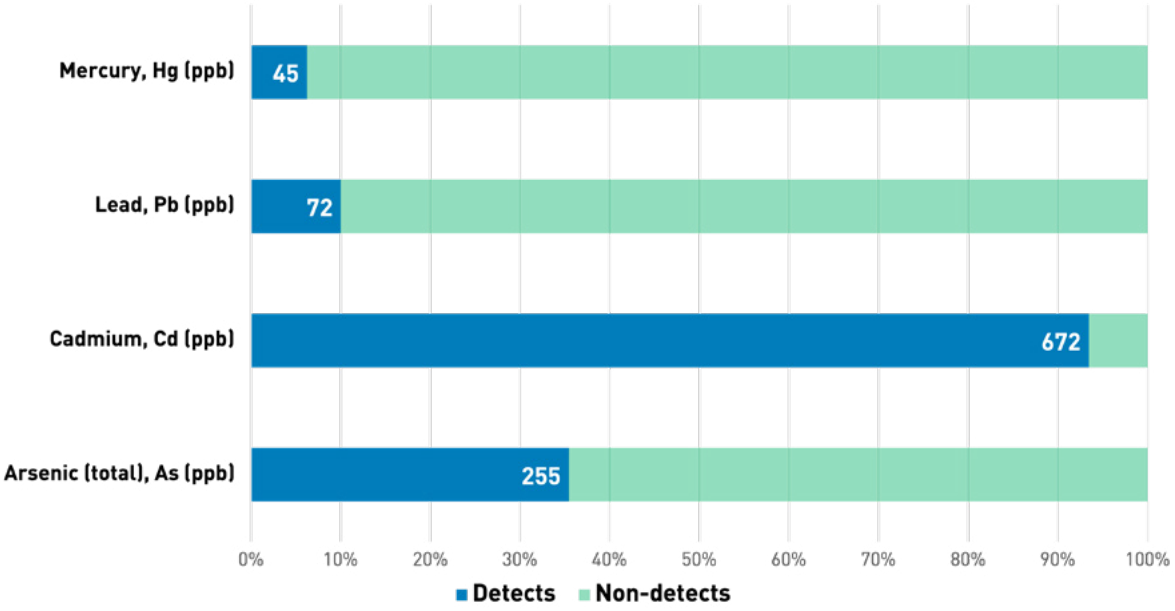

Figure 9: Selected Toxic Elements, Percent Detects/Non-detects in Vegetables

While cadmium was detected in most vegetable samples, many concentrations were low, as shown in Figure 10 (which charts the minimum, mean and maximum concentrations of 10 vegetables with the highest mean cadmium concentration).

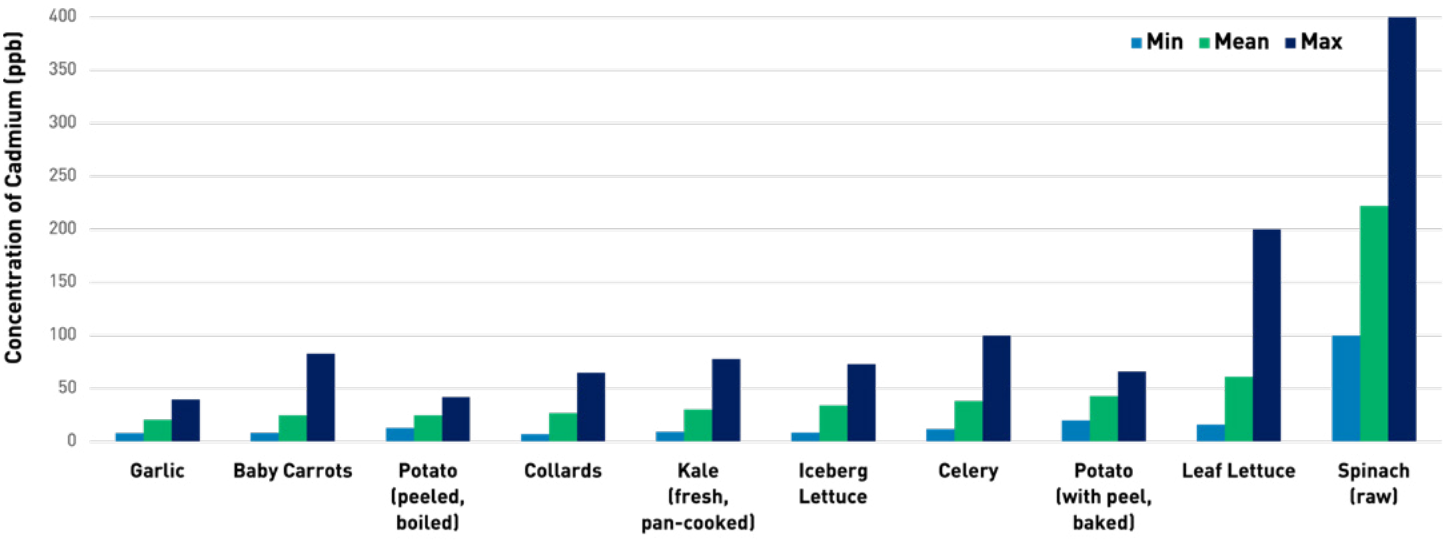

Figure 10: Vegetables (10) with Highest Mean Cadmium Concentrations

Fruits

Total arsenic (39% detects), cadmium (28% detects), lead (4% detects), and mercury (1% detects) were detected in less than half of the FY2018-FY2020 fruit samples (mean concentrations in fruits range from: total arsenic, ND – 23 ppb; cadmium, ND – 9.3 ppb; lead, ND – 9.7 ppb; mercury, ND – 1.3 ppb [only one fruit food, raisins, had detectable levels]).

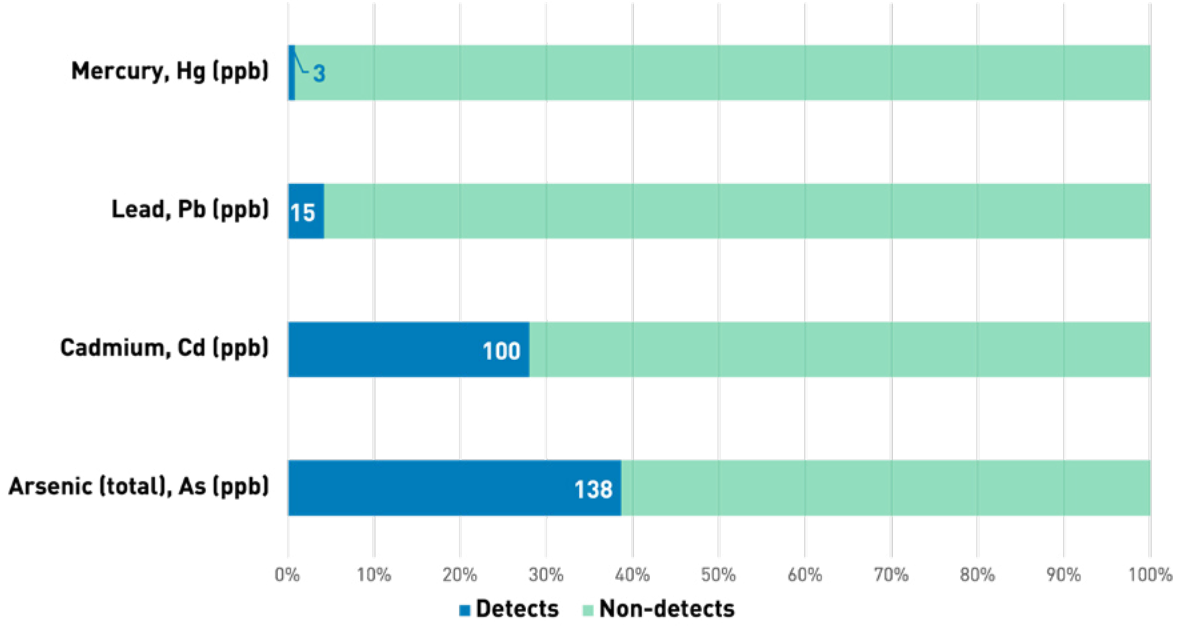

Figure 11: Selected Toxic Elements, Percent Detects/Non-detects in Fruits

For fruits, total arsenic was detected more frequently than cadmium, lead, or mercury. However, as the

case with cadmium in vegetables, many concentrations were low, as shown in Figure 12 (which charts the minimum, mean and maximum concentrations for 10 fruits with the highest mean total arsenic concentration).

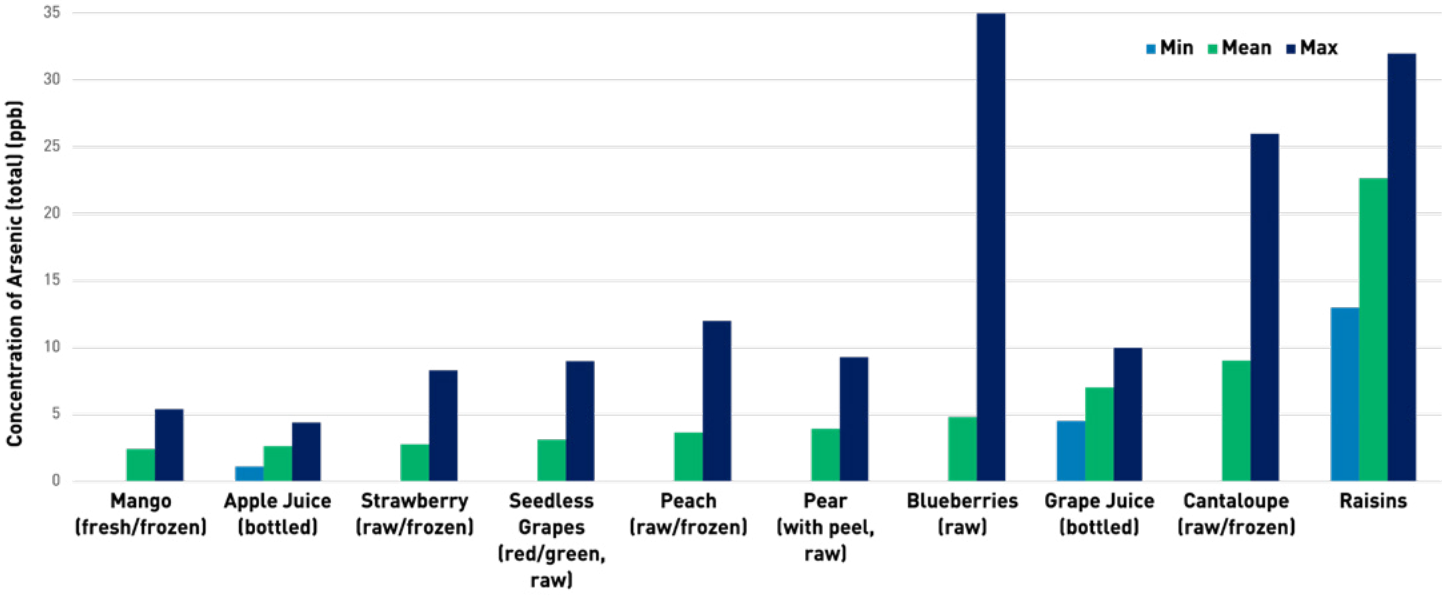

Figure 12: Fruits (10) with Highest Mean Total Arsenic Concentrations

Dairy

Total arsenic (2% detects), cadmium (3% detects), lead (1% detects), and mercury (0% detects) were rarely detected in the FY2018-FY2020 dairy samples (mean concentrations in dairy range from: total arsenic, ND – 8.2 ppb; cadmium, ND – 4.9 ppb; lead, ND – 2.1 ppb; mercury, all ND).

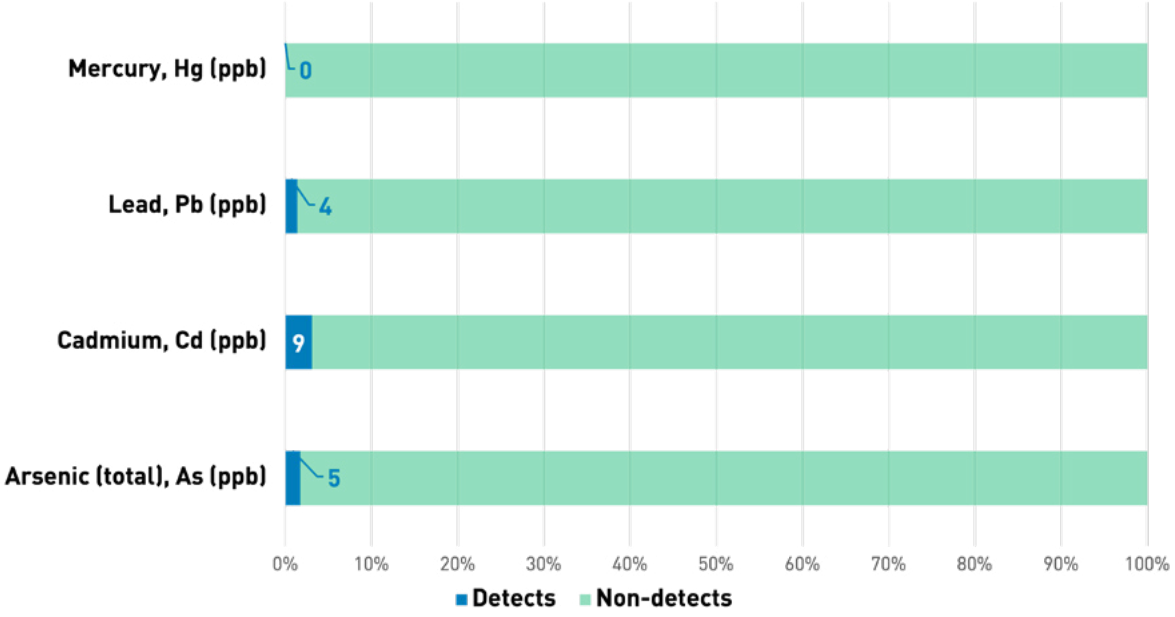

Figure 13: Selected Toxic Elements, Percent Detects/Non-detects in Dairy

4.3 New and Changed TDS Foods

The FY2018-FY2020 reporting cycle included new foods added to the TDS, as well as foods where preparation methods changed. These changes reflect: increased consumption of the food, ingredient foods and more common preparation methods for foods. Three examples of new and changed foods are provided to illustrate these reasons.

Coconut water was collected for the first time in FY2018. Results for coconut water indicate this beverage may be a source of potassium (mean concentration = 1500 ppm) and manganese (mean concentration = 2367 ppb).

Chicken broth is an ingredient in many recipes. Chicken broth was high in sodium, as expected. However, no toxic elements were detected. The only detectable results for chicken broth were nutrient elements.

Eggplant was prepared differently in FY2018 (starting with FY2018 Collection 7). The new preparation is the eggplant is baked with its peel. The previous preparation required peeling the eggplant and then boiling it. Mean iron concentrations differed between the baked and boiled eggplant samples. Eggplant (baked with peel) had a mean iron concentration of 2076 ppb and eggplant (peeled and boiled) had a mean iron concentration of 1667 ppb. Similar results are seen for potassium, where mean potassium results for eggplant peeled and boiled (1067 ppm) are half that of eggplant baked with peel (2214 ppm). Further analysis is needed to identify the source(s) of these differences.

4.4 Additional Samples of Baby Foods

The TDS has collected and analyzed baby foods since 1975. In the modernized TDS, baby foods are considered national foods (i.e., not expected to vary by region) and therefore are collected once per year as part of the national collection. In FY2019 FDA collected additional samples of baby foods to obtain information about baby foods with unique ingredients and baby foods with higher consumption (per NHANES/WWEIA). The FY2019 additional baby food sampling was conducted in tandem with select regional collections, and therefore also provided an opportunity to compare certain baby foods collected regionally and nationally. In general, the region and season did not have an impact on the analytical results for elements in baby foods. For a summary of analytical results for elements for each food, see the TDS website (FDA, 2022c), where the summary is available to download.

The additional baby food sampling contributed to a total of 384 baby food samples in the FY2018-FY2020 reporting cycle. Of the 1536 analytical results for toxic elements, 995 (65%) were non-detects and 541 (35%) had detectable levels.

Approximately 51% of the baby food samples analyzed had detectable levels of total arsenic. The highest levels of total arsenic were found in infant cereals and snacks like teething biscuits and puffed snacks. These results agree with historical TDS data as well as sampling performed to support the Arsenic in Rice and Rice Products Risk Assessment (FDA, 2016). Six baby foods containing rice and/or juice exceeded a specified level of total arsenic and were therefore further analyzed to determine the levels of inorganic arsenic. These results are provided in Table 4 below (further information on the total arsenic levels that result in speciation can be found in Appendix B, Table 10 and additional details on arsenic speciation results can be found on the TDS website [FDA, 2022c], where the summary of analytical findings for each food is available to download).

Table 4: Arsenic Speciation Analytical Results for Baby Foods

Baby Food Type	Arsenic (total) Mean Conc. (ppb)	Number of Samples Analyzed for Arsenic (total)	Inorganic Arsenic Mean Concentration (ppb)	Number of Samples Analyzed for Inorganic Arsenic
Grape juice	9.2	8	7.4	3
Puffed snack	42	8	31	8
Mixed cereal (multi-grain), dry	32	7	26	6
Rice cereal, dry	109	9	73	9
Rice cereal, prepared with water	23	13	17	13
Teething biscuits	24	8	23	8

Cadmium was not detected in 35% of the 384 baby food samples. The highest level (49 ppb) of cadmium was in a sample of baby food containing spinach as an ingredient. The baby food products containing spinach had levels of cadmium which align with the TDS results for cadmium in raw spinach. The second highest result for cadmium was 41 ppb in baby food carrots. However, the mean concentration of cadmium was 20 ppb across the 14 baby food carrot samples.

Lead and mercury were not detected in 79% and 97%, respectively of the 384 baby food samples. The highest baby food lead result (38 ppb) was found in a sample of baby food sweet potatoes. There were only 13 samples with detectable results for mercury and all 13 were less than 3 ppb.

5. Conclusion

The analytical results of the FY2018-FY2020 reporting cycle demonstrate the value of the modernized TDS as a source of monitoring information on nutrient and contaminant element concentrations in foods consumed by the US population. The continuous nature of TDS allows for looking at analyte concentrations in foods over time. The results from FY2018-FY2020 did not identify element concentrations outside of historical levels for foods collected previously. The data provide information on new foods (including ingredient foods) and the impact of different preparation methods (e.g., baked versus boiled, cooked versus raw) on element concentrations.

This report focuses on TDS element analytes, separate reports will summarize the pesticide and radionuclide analytical results; as well as provide dietary exposure assessments.

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Appendices

Appendix A: Study Design

Appendix A – Table 5: TDS Foods, Collection Amounts, and Preparation Information

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
Alcohol, distilled, vodka	National	3750 mL								
Alcohol, distilled, whiskey/scotch	National	3000 mL								
Almonds, shelled	National	1020 g								
Apple, red, with peel, raw	Regional	5443 g	X							
Applesauce, bottled	National	2630 g								
Asparagus, fresh/frozen, boiled	Regional	4762 g	X				X			
Avocado, raw	Regional	5443 g	X	X						
Bagel, plain, toasted	Regional	2721 g							X	
Baking powder	National	907 g								
Banana, raw	Regional	5443 g		X						
Beans, black, canned, drained solids	National	1700 g								
Beans, garbanzo (chickpeas), canned, drained solids	National	3401 g								
Beans, kidney, canned, drained solids	National	1786 g								
Beans, pinto, canned, drained solids	National	1700 g								
Beans, refried, canned	National	1814 g								
Beans, white, canned, drained solids	National	1746 g								
Beef steak, loin/sirloin, oven-roasted	Regional	4082 g				X				
Beef, ground, pan-cooked	Regional	4082 g			X					
Beer	National	5678 mL								
Beverage, almond (non-dairy)	National	3785 mL								
Beverage, coconut water	National	5796 mL								
Beverage, energy	National	1892 mL								
Beverage, soy (non-dairy)	National	3785 mL								
Beverage, sports	National	4731 mL								

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
BF, apple & sweet potato with cinnamon, pouch	Additional	2083 g								
BF, apple, spinach & avocado, bowl/pouch	Additional	2083 g								
BF, apple, sweet potato & pineapple, pouch	Additional	2083 g								
BF, apples with berries	National	1814 g								
BF, apples with fruit other than berries	National	1814 g								
BF, applesauce	National	1814 g								
BF, banana & blueberry, pouch	Additional	2041 g								
BF, banana & strawberry, glass jar	Additional	2041 g								
BF, banana, apple & pear, plastic jar	Additional	2041 g								
BF, banana, blackberry & blueberry, plastic jar	Additional	2041 g								
BF, bananas	National	1814 g								
BF, beef and broth/gravy	National	1488 g								
BF, carrots	National	2721 g								
BF, cereal, mixed, dry	National	2041 g								
BF, cereal, mixed, dry, prepared with water	National	2041 g								Prepare with water.
BF, cereal, oatmeal, dry	National	2041 g								
BF, cereal, oatmeal, dry, prepared with water	National	2041 g								Prepare with water.
BF, cereal, rice, dry	National	2041 g								
BF, cereal, rice, dry, prepared with water	Regional	6123 g								Prepare with water.
BF, chicken noodle dinner	National	1814 g								
BF, finger foods, puffed snack	National	1700 g								
BF, fruit yogurt dessert	National	2154 g								
BF, green beans	National	1814 g								
BF, infant formula, milk-based, powdered	National	2041 g								
BF, infant formula, milk-based, powdered, prepared with water	National	2041 g								Prepare according to package instructions.
BF, infant formula, soy-based, powdered	National	2041 g								
BF, infant formula, soy-based, powdered, prepared with water	National	2041 g								Prepare according to package instructions.
BF, juice, apple	National	1892 mL								

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
BF, juice, grape	National	1892 mL								
BF, juice, mixed fruit	Additional	2839 mL								
BF, juice, pear	National	1892 mL								
BF, macaroni and cheese with vegetables	National	1814 g								
BF, mango, carrot & turmeric, bowl	Additional	2083 g								
BF, mango, glass jar	Additional	2041 g								
BF, mango, pouch	Additional	2083 g								
BF, mango, yellow zucchini, corn & turmeric, pouch	Additional	2083 g								
BF, mixed vegetables	National	1814 g								
BF, organic pears & spinach, pouch	Additional	2083 g								
BF, organic yogurt, apple, pumpkin, cinnamon & quinoa, pouch	Additional	2083 g								
BF, pasta, tomato and beef	National	2551 g								
BF, peaches	National	1814 g								
BF, pear, blueberry, apple & avocado, pouch	Additional	2083 g								
BF, pear, mango, avocado, pouch	Additional	2083 g								
BF, pears	National	1814 g								
BF, peas	National	1814 g								
BF, peas & spinach, glass jar	Additional	2041 g								
BF, peas, green beans & avocado, pouch	Additional	2083 g								
BF, prunes	National	2267 g								
BF, pumpkin, banana, papaya & cardamom, bowl	Additional	2083 g								
BF, ravioli, cheese-filled, with tomato sauce	National	5613 g								
BF, squash	National	1814 g								
BF, sweet potato, apple & corn, pouch	Additional	2083 g								
BF, sweet potato, apple & spinach, pouch	Additional	2083 g								
BF, sweet potatoes	National	1814 g								
BF, teething biscuits	National	1512 g								
BF, turkey and broth/gravy	National	1488 g								
BF, turkey and rice	National	1814 g								

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
BF, turkey, quinoa, apple & sweet potato, pouch	Additional	2083 g								
BF, vegetables and beef	National	1814 g								
BF, vegetables and chicken	National	1814 g								
BF, vegetables and turkey	National	1814 g								
BF, water, baby, bottled	National	7570 mL								
BF, yogurt, peach pear	Additional	2041 g								
Biscuits, fast-food	Regional	60 biscuits								
Blueberries, raw	Regional	2664 g	X							
Bread, white roll/bun (hamburger/hotdog)	Regional	2721 g								
Bread, white, enriched, pre-sliced	Regional	2721 g								
Bread, whole wheat, pre-sliced	Regional	3401 g								
Breadcrumbs	National	1700 g								
Breakfast tart/toaster pastry	National	1247 g							X	Prepare according to package instructions.
Broccoli, fresh/frozen, boiled	Regional	5443 g	X				X			
Broth, chicken, cartooned	National	1814 g								
Brown gravy, canned or bottled	National	1360 g								
Brownie	National	2075 g				X				Bake according to package instructions.
Brussels sprouts, fresh/frozen, boiled	Regional	4082 g	X				X			
Butter, salted	National	1360 g								
Cabbage, raw	Regional	4082 g	X							
Cake, chocolate with chocolate icing	Regional	4082 g								
Cake, white with white icing	Regional	4082 g								
Candies, fruit snacks	National	2834 g								
Candy bar, chocolate, nougat, with nuts	National	1898 g								
Candy bar, milk chocolate, plain	National	1581 g								
Candy, hard	National	1417 g								
Cantaloupe, raw/frozen	Regional	5443 g	X	X						Remove rind.
Carbonated beverage, cola, diet	National	2000 mL								
Carbonated beverage, cola, regular	National	2000 mL								
Carbonated beverage, lemon-lime, regular	National	2000 mL								

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
Carrot, baby, raw	Regional	2721 g	X							
Cashews, salted	National	1644 g								
Catfish, pan-cooked with oil	Regional	4082 g			X					
Cauliflower, fresh/frozen, boiled	Regional	4082 g	X				X			
Celery, raw	Regional	2721 g	X							
Cereal, bran with raisins	National	2041 g								
Cereal, corn flakes	National	2721 g								
Cereal, crisped rice	National	2381 g								
Cereal, granola	National	2608 g								
Cereal, oat ring	National	2267 g								
Cereal, oat ring, honey	National	2313 g								
Cereal, shredded wheat, frosted	National	2041 g								
Cereal, whole wheat, cooked	National	1020 g								Cook according to package instructions.
Cheese, American, processed	National	1814 g								
Cheese, cheddar (sharp/mild)	Regional	4082 g								
Cheese, Monterey jack	Regional	4082 g								
Cheese, mozzarella	Regional	4082 g								
Cheese, Swiss	Regional	4082 g								
Chicken breast, fried with skin, fast-food	Regional	4082 g								
Chicken breast, oven-roasted, skin removed	Regional	5443 g				X				
Chicken leg, fried with skin, fast-food	Regional	4082 g								
Chicken nuggets, fast-food	Regional	2721 g								
Chicken potpie, frozen, heated	National	1417 g				X				
Chicken thigh, oven-roasted, skin removed	Regional	4082 g				X				
Chili con carne with beans, canned	National	2551 g								
Chips, potato	National	2381 g								
Chips, tortilla	National	2976 g								
Cinnamon roll, iced	Regional	3401 g								
Cocoa powder	National	907 g								
Cod, baked	Regional	4082 g				X				
Coffee, brewed from ground	National	1187 g					X			

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
Collards, fresh/frozen, boiled	Regional	4762 g	X				X			
Cookies, chocolate chip	National	1417 g								
Cookies, sandwich, with crème filling	National	1445 g								
Cookies, sugar	National	1080 g				X				
Corn, canned, drained solids	National	1700 g								
Corn, frozen, boiled	Regional	4082 g					X			
Corn/hominy grits, enriched, cooked	National	680 g								Cook according to package instructions. Do not add salt.
Cornbread, homemade	National	3855 g				X				
Cottage cheese, creamed, reduced fat	National	2721 g								
Crackers, butter-type	National	1133 g								
Crackers, cheese	National	595 g								
Crackers, graham	National	1224 g								
Crackers, saltine	National	907 g								
Cream cheese	National	1360 g								
Cream of wheat (farina), enriched, cooked	National	793 g								Cook according to package instructions. Do not add salt.
Cream substitute, non-dairy, liquid	National	2721 g								
Cream, half and half	Regional	5678 mL								
Cucumber, peeled, raw	Regional	5443 g	X	X						
Doughnut, cake-type, plain	National	2154 g								
Eggplant, baked with peel	Regional	6803 g	X			X				
Eggplant, fresh, peeled, boiled	Regional	20411 g	X	X			X			
Eggs, hard-boiled	Regional	12 dozen eggs		X see notes			X			Peel after cooking.
English muffin, plain, toasted	Regional	2721 g							X	
Fish sticks or patty, frozen, oven-cooked	National	2608 g				X				
Flour, white, all-purpose	National	4535 g								
Frankfurter, (all beef/beef and pork), boiled	National	2494 g					X			
Fruit cocktail, canned in light syrup, solids and liquids	National	1700 g								
Fruit drink (5%–25% juice), canned or bottled	National	7452 mL								
Fruit drink, from powder	National	13 g								

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
Fruit juice blend (100% juice), canned/ bottled	National	5175 mL								
Garlic, raw	Regional	2721 g		X						
Gelatin dessert, strawberry	National	1417 g								
Granola bar	National	1852 g								
Grapefruit, raw	Regional	4082 g	X	X						
Grapes, seedless, red/green, raw	Regional	4082 g	X							
Green beans, canned, drained solids	National	1587 g								
Green beans, fresh/frozen, boiled	Regional	5443 g	X				X			
Ham, cured (not canned), baked	Regional	4082 g				X				
Honey	National	1360 g								
Ice cream, chocolate	Regional	5678 mL								
Ice cream, vanilla	Regional	11356 mL								
Jelly, grape	National	1757 g								
Juice, apple, bottled	National	1892 mL								
Juice, cranberry cocktail, bottled	National	1892 mL								
Juice, grape, bottled	National	3785 mL								
Juice, grapefruit, bottled/cartoned	National	3075 mL								
Juice, lemon	National	1892 mL								
Juice, orange, bottled/cartoned	National	3430 mL								
Juice, pineapple, canned	National	1360 mL								
Juice, tomato-vegetable	National	1892 mL								
Kale, fresh, pan-cooked	Regional	4082 g	X		X					
Ketchup, tomato	National	1814 g								
Lamb chop, pan-cooked with oil	Regional	8164 g			X					
Lentils, dry, cooked	National	907 g								
Lettuce, iceberg, raw	Regional	5443 g	X	X						Remove outer leaves.
Lettuce, leaf, raw	Regional	4082 g	X							Remove outer leaves.
Lima beans, immature, frozen, boiled	National	1814 g					X			
Luncheon meat, bologna	National	1927 g								
Luncheon meat, ham	National	1814 g								
Luncheon meat, turkey	National	1814 g								

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
Macaroni and cheese, prepared from boxed mix	National	1027 g					X			Prepare according to package instructions.
Mango, raw/frozen	Regional	6803 g	X	X						
Margarine, salted	National	2551 g								
Mayonnaise	National	1700 g								
Meal replacement, liquid RTD, vanilla	National	1419 mL								
Milk shake, vanilla, fast-food	Regional	11711 mL								
Milk, chocolate, reduced fat, fluid	Regional	5678 mL								
Milk, reduced fat, fluid	Regional	5678 mL								
Milk, skim, fluid	Regional	5678 mL								
Milk, whole, fluid	Regional	5678 mL								
Mixed vegetables, frozen, boiled	National	1814 g					X			
Muffin, blueberry	Regional	4762 g								
Mushrooms, canned, drained solids	National	1105 g								
Mushrooms, raw	Regional	3401 g	X							
Mustard, yellow, plain	National	1133 g								
Noodles, egg, enriched, boiled	National	1020 g					X			Cook according to package instructions. Do not add salt. Drain.
Oatmeal, plain, quick, cooked	National	510 g								Cook according to package instructions. Do not add salt.
Oil, olive	National	1417 g								
Oil, vegetable	National	2721 g								
Olives, black, pitted	National	1020 g								
Onion, mature, raw	Regional	2721 g		X						Remove outer skin.
Orange, raw	Regional	5443 g	X	X						
Pancakes, frozen, heated	National	2954 g						X		Prepare according to package instructions.
Pasta, rice noodles, cooked	National	1041 g					X			Cook according to package instructions. Do not add salt. Drain.
Pasta, whole wheat, cooked	National	907 g					X			Cook according to package instructions. Do not add salt. Drain.
Peach, raw/frozen	Regional	4082 g	X							

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
Peanut butter, creamy	National	2267 g								
Peanuts, dry roasted, salted	National	1814 g								
Pear, with peel, raw	Regional	5443 g	X							
Peas, green, frozen, boiled	National	1360 g					X			
Pepper, bell, green, raw	Regional	5443 g	X							
Pickles, dill, cucumber	National	1814 g								
Pie crust	National	1133 g				X				
Pie, apple, fresh/frozen	National	2494 g				X				
Pie, pumpkin, fresh/frozen	National	2409 g				X				
Pineapple, raw/frozen	Regional	4082 g	X	X see notes						Peel if raw.
Pizza, cheese, fast-food	Regional	6 medium pizzas								
Popcorn, microwave, butter-flavored	National	1571 g						X		
Popsicle, fruit-flavored	National	1756 mL								
Pork and beans, canned	National	1700 g								
Pork bacon, oven-cooked	Regional	6803 g				X				
Pork chop, pan-cooked with oil	Regional	5443 g			X					
Pork sausage (link/patty), pan-cooked	Regional	5443 g			X					
Potato, peeled, boiled	Regional	6803 g	X	X			X			
Potato, with peel, baked	Regional	6803 g	X			X				
Potatoes, French fries, fast-food	Regional	4082 g								
Powder, protein	National	1814 g								
Pretzels, hard, salted	National	1757 g								
Pudding, ready-to-eat, chocolate	National	1360 g								
Quinoa, cooked	National	453 g					X			Cook with water according to package instructions.
Raisins	National	1247 g								
Rice, brown, cooked	Regional	1360 g					X			
Rice, white, enriched, cooked	Regional	1360 g					X			
Salad dressing, Italian, regular	National	1833 mL								
Salad dressing, ranch, low-calorie	National	1833 mL								
Salad dressing, ranch, regular	National	946 mL								
Salami, dry/hard	Regional	2721 g								

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
Salmon, steaks/fillets, baked	Regional	4082 g				X				
Salsa, tomato, bottled	National	1700 g								
Salt, iodized	National	1474 g								
Salt, sea	National	2092 g								
Sauce, barbecue	Regional	4082 g								
Sauce, soy	National	1774 mL								
Sauce, tomato, canned	National	1814 g								
Sauce, tomato, pasta	National	1360 g								
Seeds, sunflower, shelled, salted, roasted	National	2551 g								
Shrimp, pre-cooked, shells removed, no tails	Regional	2721 g								
Sorbet, fruit-flavored	National	1656 mL								
Soup, broccoli cheese, canned, condensed, prepared with water	National	1133 g								Prepare with warm water.
Soup, chicken noodle, canned, condensed, prepared with water	National	1190 g								Prepare with hot water and mix.
Soup, clam chowder, New England, canned, ready to serve	National	2041 g								
Soup, cream of mushroom, canned, condensed, prepared with water	National	1133 g								Prepare with warm water.
Soup, cream of potato, canned, condensed, prepared with water	National	1133 g								Prepare with warm water.
Soup, ramen noodles, prepared with water	National	425 g					X			Prepare with water according to package instructions.
Soup, tomato, canned, condensed, prepared with water	National	1133 g								Prepare with hot water and mix.
Soup, vegetable beef, canned, ready to serve	National	2041 g								
Soup, vegetable, canned, ready to serve	National	2041 g								
Sour cream	National	1814 g								
Spaghetti, enriched, boiled	National	907 g					X			Cook according to package instructions. Do not add salt. Drain.
Spinach, raw	Regional	4082 g								
Squash, winter, fresh/frozen, boiled	Regional	6123 g	X	X see notes		X				Peel after baking.
Strawberry, raw/frozen	Regional	5443 g	X							

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

TDS Food Description	TDS List	Amount Collected	Prepare/ Wash	Prepare/ Peel	Cook/ Fry	Cook/ Bake	Cook/ Boil	Cook/ Micro-wave	Toast	Notes
Sugar, white, granulated	National	5443 g								
Sweet potato, baked, peel removed	Regional	4082 g	X	X see notes						Peel after baking.
Syrup, chocolate-flavored	National	1360 g								
Syrup, pancake	National	1360 g								
Tea, brewed from tea bag	National	382 g					X			
Tilapia, baked	Regional	4082 g				X				
Tofu, firm, plain, drained solids	National	2608 g								
Tomato, raw	Regional	4082 g	X							
Tortilla, corn	Regional	150 tortillas								
Tortilla, flour	Regional	4082 g								
Tuna, canned in water, drained solids	National	3401 g								
Turkey breast, oven-roasted	Regional	5443 g				X				
Turkey, ground, pan-cooked	Regional	2721 g			X					
Veggie burger	National	1530 g								Prepare according to package instructions.
Walnuts, shelled	National	2721 g								
Water, bottled, mineral/spring	Regional	6387 mL								
Watermelon, raw/frozen	Regional	6803 g	X	X						Remove rind.
Wine, red	National	2250 mL								
Wine, white	National	2250 mL								
Yogurt, frozen, vanilla	Regional	11356 mL								
Yogurt, lowfat, fruit-flavored	National	2112 g								
Yogurt, lowfat, vanilla	National	907 g								
Zucchini, fresh/frozen, boiled	Regional	4762 g	X				X			

Bolded TDS Food Descriptions are core TDS foods (sampled all three years of the FY2018-FY2020 reporting cycle)

Appendix A – Table 6: Fiscal Years 2018-2020 FDA TDS Collection Sites

Fiscal Year	Collection	Month	Season	TDS Region	City 1	City 2	City 3
2018	1	October	Winter	Mid-Atlantic	Welch, WV	Clarksville, TN	Baltimore, MD
2018	2	November	Winter	North Central	Clio, MI	Holland, MI	South Bend, IN
2018	3	December	Winter	Southeast	Spartanburg, SC	McDonough, GA	Miami, FL
2018	4	January	Winter	Southwest	Dallas, TX	Denver, CO	Coolidge, TX
2018	5	February	Winter	Southeast	N. Lauderdale, FL	Kennesaw, GA	Daytona Beach, FL
2018	6	March	Winter	Northeast	Allentown, PA	Syracuse, NY	Philadelphia, PA
2018	7	April	Summer	West	Bonney Lake, WA	Sacramento, CA	Exeter, CA
2018	8	May	Summer	Northeast	Buffalo, NY	Billerica, MA	Jackson, NJ
2018	9	June	Summer	Southwest	College Station, TX	Oklahoma City, OK	Brigham City, UT
2018	10	July	Summer	Mid-Atlantic	Stow, OH	High Point, NC	Richmond, VA
2018	11	August	Summer	West	Reseda, CA	Los Angeles, CA	Davis, CA
2018	12	September	Summer	North Central	Milwaukee, WI	Savage, MN	Detroit, MI
2018	13	April, June	Summer	National	Shawnee and Lenexa, KS	N/A	N/A
2019	1	Oct	Winter	West	Pittsburg, CA	Bass Lake, CA	Costa Mesa, CA
2019	2	Nov	Winter	Southeast	Baton Rouge, LA	Albertville, AL	Conyers, GA
2019	3	Dec	Winter	Northeast	Mount Holly, NJ	Floral Park, NY	Pittsburgh, PA
2019	4	Jan	Winter	Furlough	Furlough	Furlough	Furlough
2019	5	Feb	Winter	Furlough	Furlough	Furlough	Furlough
2019	6	Mar	Winter	Mid-Atlantic	Glouster, OH	Kannapolis, NC	Greeneville, TN
2019	7	Apr	Summer	Southeast	Montgomery, AL	West Palm Beach, FL	Florence, SC

Fiscal Year	Collection	Month	Season	TDS Region	City 1	City 2	City 3
2019	8	May	Summer	North Central	Chicago, IL	Indianapolis, IN	Wahpeton, ND
2019	9	June	Summer	West	Laramie, WY	Eugene, OR	San Diego, CA
2019	10	July	Summer	Northeast	Jamaica, NY	Warren, PA	Saco, ME
2019	11	Aug	Summer	Mid-Atlantic	Fairfax, VA	Toledo, OH	Medina, OH
2019	12	Sept	Summer	Southwest	Mission, TX	El Mirage, AZ	Austin, TX
2019	13	October	Winter	National	Lenexa, KS	N/A	N/A
2020	1	October	Winter	Northeast	Bronx, NY	Waterbury, CT	Trenton, NJ
2020	2	November	Winter	Southwest	Houston, TX	Cypress, TX	Oklahoma City, OK
2020	3	December	Winter	Mid-Atlantic	Cincinnati, OH	Xenia, OH	Maiden, NC
2020	4	January	Winter	West	San Francisco, CA	Los Angeles, CA	Topanga, CA
2020	5	February	Winter	North Central	Romeovil, IL	Sun Prairie, WI	Burnsville, MN
2020	6	March	Winter	Southeast	Ft. McCoy, FL	Huntsville, AL	Doral, FL
2020	7	April	Summer	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic
2020	8	May	Summer	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic
2020	9	June	Summer	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic
2020	10	July	Summer	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic
2020	11	August	Summer	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic
2020	12	September	Summer	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic	COVID-19 Pandemic
2020	13	January	Winter	National	Shawnee and Lenexa, KS	N/A	N/A

N/A: Not applicable

Appendix B: Summary of Analytical Methods and Reporting Limits for Elements

The TDS uses the analytical methods outlined in the FDA Elemental Analysis Manual (EAM) to analyze foods. Tables 7, 8 and 9 below summarize the EAM reference, analytical method, instruments, sample weights and reporting limits used to determine the concentrations of specific analytes in foods (FDA, 2022b). The reporting limits are administrative limits, based on limit of detection (LOD) and limit of quantification (LOQ) values across years. Analyte concentrations below reporting limits are not-detected (ND).

Appendix B – Table 7: Analytical Methods and Reporting Limits for Elements in Foods and Beverages

Reference	Analytical Technique	Instrument	Analyte	Units	Reporting Limit (0.4 g Sample Weight)	Reporting Limit (0.5 g Sample Weight)	Reporting Limit (0.8 g Sample Weight)	Reporting Limit (1 g Sample Weight)	Reporting Limit (2.5 g Sample Weight)	Reporting Limit (5 g Sample Weight)
EAM 4.4	ICP-AES	Agilent 5100	Calcium	ppm	10	10	6.0	5.0		1.0
EAM 4.4	ICP-AES	Agilent 5100	Magnesium	ppm	10	10	6.0	5.0		1.0
EAM 4.4	ICP-AES	Agilent 5100	Phosphorus	ppm	13	13	13	10		2.0
EAM 4.4	ICP-AES	Agilent 5100	Potassium	ppm	13	13	13	10		2.0
EAM 4.4	ICP-AES	Agilent 5100	Sodium	ppm	13	13	13	10		2.0
EAM 4.4	ICP-AESa[15]	Agilent 5100	Copper	ppb	625	625	250	200		50
EAM 4.4	ICP-AES[15]	Agilent 5100	Iron	ppb	1875	1500	1000	750		150
EAM 4.4	ICP-AES[15]	Agilent 5100	Strontium	ppb	500	500	130	100		40
EAM 4.4	ICP-AES[15]	Agilent 5100	Zinc	ppb	630	400	250	200		50
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Arsenic (total)	ppb	7.0	7.0	4.0	3.0		1.0

15. The analyte was measured by the instrument in ppm, results were converted to ppb
EAM: Elemental Analysis Manual
ICP-AES: Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS: Inductively Coupled Plasma-Mass Spectrometry

Reference	Analytical Technique	Instrument	Analyte	Units	Reporting Limit (0.4 g Sample Weight)	Reporting Limit (0.5 g Sample Weight)	Reporting Limit (0.8 g Sample Weight)	Reporting Limit (1 g Sample Weight)	Reporting Limit (2.5 g Sample Weight)	Reporting Limit (5 g Sample Weight)
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Cadmium	ppb	3.0	3.0	2.0	1.0		1.0
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Chromium	ppb	125	125	130	50		25
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Lead	ppb	10	10.0	5.0	4.0		1.0
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Manganese	ppb	250	200	130	100		25
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Mercury	ppb	3.0	3.0	1.0	1.0		1.0
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Molybdenum	ppb	75	75	60	30		20
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Nickel	ppb	100	100	60	40		20
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Selenium	ppb	25	25	13	10		3.0
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Uranium	ppb	2.5	2.0	2.0	1.0		1.0
EAM 4.7	ICP-MS	Agilent 7700, 7900, and 8900	Vanadium	ppb	25	20	13	10		3
EAM 4.13	ICP-MS	Agilent 7900	Iodine	ppb		25			5	3

EAM: Elemental Analysis Manual
ICP-MS: Inductively Coupled Plasma-Mass Spectrometry

Appendix B – Table 8: Analytical Methods and Reporting Limits for Elements in Water

Referencea[16]	Analytical Technique	Instrument	Analyte	Units	Reporting Limit (25 g Sample Weight)
EAM 4.4	ICP-AES	Agilent 5100	Calcium	ppm	0.3
EAM 4.4	ICP-AES	Agilent 5100	Magnesium	ppm	0.015
EAM 4.4	ICP-AES	Agilent 5100	Potassium	ppm	0.08
EAM 4.4	ICP-AES	Agilent 5100	Sodium	ppm	0.15
EAM 4.4	ICP-AES[17]	Agilent 5100	Strontium	ppb	0.2
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Antimony	ppb	0.04
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Arsenic (total)	ppb	0.05
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Barium	ppb	0.5
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Beryllium	ppb	0.04
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Cadmium	ppb	0.03
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Chromium	ppb	4
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Copper	ppb	2.5
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Iron	ppb	25
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Lead	ppb	0.4
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Manganese	ppb	0.4
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Mercury	ppb	0.03
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Nickel	ppb	2
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Selenium	ppb	0.4
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Thallium	ppb	0.3
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Uranium	ppb	0.05
EAM 4.12	ICP-MS	Agilent 7700, 7900 and/or 8900	Zinc	ppb	9
EAM 4.13	ICP-MS	Agilent 7900	Iodine[18]	ppb	3

16. A modified EAM 4.4 and a draft EAM 4.12 were used to generate the FY18-FY20 water element analytic results
17. The analyte was measured by the instrument in ppm, results were converted to ppb
18. The sample weight used to determine the concentration of iodine in water was 5 g
ICP-AES: Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS: Inductively Coupled Plasma-Mass Spectrometry
EAM: Elemental Analysis Manual

Appendix B – Table 9: Arsenic Speciation Analytical Methods and Reporting Limits

Reference	Analytical Technique	Instrument	Analyte	Units	Reporting Limit (0.8 g Sample Weight)	Reporting Limit (1 g Sample Weight)	Reporting Limit (5 g Sample Weight)
EAM 4.10 and 4.11	HPLC in combination with ICP-MS	Agilent 7700 and 7900 coupled to Agilent 1200 or 1260	Inorganic arsenic	ppb	1.0	1.0	0.4
EAM 4.10 and 4.11	HPLC in combination with ICP-MS	Agilent 7700 and 7900 coupled to Agilent 1200 or 1260	Dimethylarsinic acid	ppb	1.0	1.0	0.4
EAM 4.10 and 4.11	HPLC in combination with ICP-MS	Agilent 7700 and 7900 coupled to Agilent 1200 or 1260	Monomethylarsonic acid	ppb	1.0	1.0	0.4

EAM: Elemental Analysis Manual
HPLC in combination with ICP-MS: High Performance Liquid Chromatography-Inductively Coupled Plasma-Mass Spectrometric Determination

Appendix B – Table 10: Select Foods and Total Arsenic Levels Resulting in Arsenic Speciation

TDS Food Description	Arsenic (total) (ppb)
Wine, red	10
Wine, white	10
BF, juice, apple	10
BF, juice, grape	10
BF, juice, pear	10
Fruit drink (5%–25% juice), canned or bottled	10
Fruit juice blend (100% juice), canned/bottled	10
Juice, apple, bottled	10
Juice, cranberry cocktail, bottled	10
Juice, grape, bottled	10
Juice, grapefruit, bottled/cartoned	10
Juice, lemon	10
Juice, orange, bottled/cartoned	10
Juice, pineapple, canned	10
Juice, tomato-vegetable	10
BF, cereal, mixed (multi-grain), dry, prepared with water	10
BF, cereal, mixed (multi-grain), dry	10
BF, finger foods, puffed snack	10
BF, teething biscuits	10
BF, turkey and rice	10
Cereal, crisped rice	100
BF, cereal, rice, dry	10
BF, cereal, rice, dry, prepared with water	10
Rice, brown, cooked	125
Rice, white, enriched, cooked	70