Pesticide Residue Monitoring Program Fiscal Year 2021 Pesticide Report

U.S. Food and Drug Administration

https://www.fda.gov/food/chemicals-metals-pesticides-food/pesticides

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Acknowledgments

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FDA Pesticide Residue Monitoring Program Reports and Data

For more information about FDA pesticide residue monitoring program reports, see https://www.fda.gov/food/pesticides/pesticide-residue-monitoring-program-reports-and-data. Since 1987, annual pesticide reports have been prepared to summarize results of the Food and Drug Administration's (FDA or the Agency) pesticide residue monitoring program. Reports from Fiscal Year (FY) 1987 to FY 1993 were published in the Journal of the Association of Official Analytical Chemists/Journal of AOAC International. FY 1993 and FY 1994 reports were published in the journal and also made available on the public FDA website (www.fda.gov). Subsequent reports are only available on the FDA website. Each report is available in the format(s) used at the time it was written.

In addition to the annual reports, specific pesticide monitoring data and statistical analyses of human and animal foods for each year are also available in text format on the FDA website as "database" files. The database files include statistical analysis of findings by multiple country/commodity/pesticide combinations, along with data for individual samples from which the summary information was compiled. Instructions and explanations of the data and statistical analyses are provided for each database file. The database files are available from FY 1996 on.

Executive Summary

Growers often use pesticides to protect their products from insects, weeds, fungi, and other pests. U.S. regulators help ensure that food produced with the use of pesticides is safe to eat by setting allowable levels called tolerances for pesticide chemical residues and by monitoring foods in the market to determine if those levels are being exceeded.
The role of the Environmental Protection Agency (EPA) is to establish pesticide tolerances on the amount of a pesticide chemical residue a food can contain. The Food and Drug Administration (FDA) is responsible for enforcing those tolerances for domestic foods shipped in interstate commerce and foods imported into the United States (U.S.).*

This report summarizes the results of FDA's pesticide monitoring program for FY 2021. The findings show that the levels of pesticide chemical residues measured by FDA in the U.S. food supply are generally in compliance with EPA pesticide tolerances.

FDA employs a three-fold strategy to enforce EPA's pesticide tolerances in human and animal foods. In its regulatory pesticide residue monitoring program, FDA selectively monitors a broad range of domestic and import commodities for residues of approximately 750 different pesticides and selected industrial compounds. FDA may also carry out focused sampling surveys for specific commodities or selected pesticides of special interest. In addition, FDA monitors the levels of pesticide chemical residues in foods prepared for consumption in its Total Diet Study (TDS), an ongoing program that monitors contaminants and nutrients in the average U.S. diet.

In FY 2021 (October 1, 2020 through September 30, 2021), FDA analyzed 1,367 human food samples (300 domestic and 1,067 import samples) in its regulatory monitoring program. FDA collected domestic human food samples from 26 states and import human food samples from 66 countries/economies.

FDA found that 96.7% of domestic and 89.3% of import human foods were compliant with federal standards. No pesticide chemical residues were detected in 35.0% of the domestic and 44.5% of the import samples.

In FY 2021, FDA also analyzed 80 animal food samples (16 domestic and 64 import samples) for pesticides. The agency found that 100% of domestic and 98.4% of import animal food samples were compliant with federal standards. No pesticide chemical residues were detected in 37.5% of the domestic and 40.6% of the import animal food samples.

In some human food commodity groups, the violation rate was higher for import samples. The higher violation rate affirms the validity of the sampling design in targeting import commodities more likely to contain violative pesticide chemical residues, and the countries more likely to export them. Factors considered in targeting import commodities include past problem areas, findings from state and federal monitoring, and foreign pesticide usage data.

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*With the exception of meat; poultry; *Siluriformes* fish, including catfish; and certain egg products regulated by the Food Safety and Inspection Service (FSIS) of the U.S. Department of Agriculture (USDA).

Sample collection and analysis in FY 2021 was significantly impacted by the COVID-19 pandemic. Approximately 68% fewer human food samples and 78% fewer animal food samples were collected in FY 2021 compared with FY 2019 (comparison with FY 2019 is more meaningful than comparison with FY 2020, because collections in FY 2020 were also impacted by the COVID-19 pandemic). In addition, more import samples were collected in FY 2021 relative to domestic samples. Domestic samples were not collected for the "Domestically Produced Animal Derived Foods" assignment, conducted in recent years. Sample collection and analysis is expected to increase in FY 2022.

Glossary and Abbreviations

TERM	DEFINITION
Action level	Human or animal food may contain a pesticide chemical residue from sources of contamination that cannot be avoided by good agricultural or manufacturing practices, such as contamination by a pesticide that persists in the environment. In the absence of an EPA tolerance, or tolerance exemption, FDA may establish an "action level" for such unavoidable pesticide chemical residues. An action level is a recommended level of a contaminant not to exceed. An action level is not legally binding, and FDA may take enforcement action on a case-by-case basis whether a contaminant is below, at, or above an action level. (http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ucm077969.htm)
Agency	U.S. Food and Drug Administration
APEC	Asia-Pacific Economic Cooperation
CFR	U.S. Code of Federal Regulations
CFSAN	FDA Center for Food Safety and Applied Nutrition
Codex	Codex Alimentarius Commission
CVM	FDA Center for Veterinary Medicine
Domestic sample	Sample of a commodity produced and held for sale in the United States.
DWPE	Detention Without Physical Examination
EPA	U.S. Environmental Protection Agency
FACTS	FDA Field Accomplishment and Compliance Tracking System database
FDA	U.S. Food and Drug Administration
FFDCA	Federal Food, Drug, and Cosmetic Act
FSCF	Food Safety Cooperation Forum
FSIS	USDA Food Safety and Inspection Service
FY	Fiscal Year
Import sample	Sample of products, which originate from another country, collected while the goods are in import status.

TERM	DEFINITION
LOD	Limit of Detection – The minimum concentration of a pesticide chemical residue that can be reliably distinguished from zero.[1]
LOQ	Limit of Quantitation – The minimum concentration of a pesticide chemical residue that can be quantified with acceptable precision.[1]
MOU	Memorandum of Understanding
MRL	Maximum Residue Level
MRM	Multiresidue Method – FDA pesticide method designed to analyze multiple pesticide chemical residues during a single analysis.
No-tolerance violation	Pesticide chemical residue found at, or above, the LOQ for pesticides in a commodity in which EPA has not established a tolerance for that particular pesticide/commodity combination or a tolerance exemption.
Over-tolerance violation	Pesticide chemical residue found at a level above an EPA tolerance.
ORA	FDA Office of Regulatory Affairs
PDP	USDA Pesticide Data Program
PPB	Parts per billion – residue concentration equivalent to microgram/kilogram
PPM	Parts per million – residue concentration equivalent to milligram/kilogram
SPS	Sanitary and Phytosanitary
SRM	Selective Residue Method – FDA pesticide method designed to analyze selected pesticide chemicals or a single pesticide chemical.
TDS	Total Diet Study
Tolerance	The EPA-established maximum residue level of a specific pesticide chemical that is permitted in or on a human or animal food in the United States. The tolerances are listed in 40 CFR Part 180 – Tolerances and Exemptions for Pesticide Chemical Residues in Food.
Trace level	Residue level less than the LOQ but greater than, or equal to, the LOD
USDA	U.S. Department of Agriculture
WTO	World Trade Organization

FDA Pesticide Residue Monitoring Program

Three federal government agencies share responsibility for the regulation and oversight of pesticide chemical residues in or on food. The U.S. Environmental Protection Agency (EPA) registers (i.e., approves) the use of pesticides and establishes tolerances for pesticide chemical residues in or on food resulting from the use of the pesticides. Tolerances are the EPA-established maximum residue levels (MRLs) of a specific pesticide chemical that is permitted in or on a human or animal food in the United States.[2] EPA also provides a strong U.S. preventive controls program by licensing pesticide applicators, conducting pesticide use inspections, and establishing and enforcing pesticide labeling provisions. The Food and Drug Administration (FDA) enforces tolerances in both import and domestic foods shipped in interstate commerce, except for meat; poultry; *Siluriformes* fish, including catfish; and certain egg products for which the Food Safety and Inspection Service (FSIS) of the U.S. Department of Agriculture (USDA) is responsible. FDA also monitors pesticide chemical residue levels in commodities representative of the U.S. diet by carrying out regional and national collections under the Total Diet Study (TDS).

Regulatory Monitoring and Enforcement

FDA samples individual lots of domestically produced and imported foods and analyzes them to determine whether they contain pesticide chemical residues that are "unsafe" within the meaning of the Federal Food, Drug, and Cosmetic Act (FFDCA). This activity is carried out pursuant to the enforcement of tolerances established by EPA and includes the monitoring of food for residues of cancelled pesticides used in the past that persist in the environment, which may be addressed by the FDA action levels. Domestic samples of foods produced and held for sale in the U.S. are typically collected close to the point of production in the distribution system, e.g., at growers, packers, and distributors. Import samples are collected when products are offered for entry into U.S. commerce. Because the EPA tolerances are established primarily for raw agricultural commodities, the emphasis of the FDA's regulatory sampling is on the unwashed, whole (unpeeled) raw commodity; however, some processed foods are also sampled.

The FDA may take regulatory action against food commodities containing pesticide chemical residues when they are found:

- at a level above an EPA tolerance for the pesticide/commodity combination, or
- in a commodity for which the EPA has not established a tolerance or a tolerance exemption for that particular pesticide/commodity combination ("no-tolerance" violations).

Foods may contain a pesticide chemical residue from sources of contamination that cannot be avoided by good agricultural or manufacturing practices, such as contamination by a pesticide that persists in the environment. The FDA may establish an "action level" for unavoidable residues that do not have a tolerance or tolerance exemption. The action level is not legally binding, but the FDA monitors unavoidable residues and may take enforcement action on a case-by-case basis, considering the action level and other factors.

For domestic foods, the FDA may issue Warning Letters to the responsible growers and seek other sanctions such as seizure to remove the food from commerce or injunction to correct the cause of the violation. Shipments of import food commodities may be refused entry into U.S. commerce. The responsible firm(s) and product(s) may be placed on an import alert under "Detention Without Physical Examination," or DWPE, which may be invoked for future shipments of that firm's commodity based on the finding of a single violative shipment. Section 801 of the FFDCA authorizes the FDA to refuse admission of regulated articles that appear to be adulterated or misbranded. Typically, the information to make this determination is obtained by physical examination of the entry, although it is not required. For example, entries of imported foods with a violative history would likely create the appearance of adulteration under the FFDCA for future shipments, based on the results obtained from previous examinations of the same foods that were found to contain violative pesticide residues. DWPE can be applied to a product or products from specific growers, manufacturers, or shippers, and may extend to a geographic area or country if the problem is demonstrated to be sufficiently broad-based.

The FDA's import alerts describe firms and products currently subject to DWPE for pesticide chemical residues and other food-related violations. There are currently four import alerts that address food products that are subject to DWPE for pesticides:

- Import Alert 99-05: "Detention Without Physical Examination of Raw Agricultural Products for Pesticides"
- Import Alert 99-08: "Detention Without Physical Examination of Processed Human and Animal Foods for Pesticides"
- Import Alert 99-14: "Countrywide Detention Without Physical Examination of Raw Agricultural Products for Pesticides"
- Import Alert 99-15: "Countrywide Detention Without Physical Examination of Processed Foods for Pesticides"

Growers, manufacturers, and shippers that have products subject to DWPE within an import alert may be asked to provide evidence of compliance for each shipment or lot of product exported to the United States. This procedure places the burden of demonstrating product compliance on the importer of record before the product can be released into domestic commerce. Firms can request removal of their product(s) from DWPE under an FDA import alert by petitioning the Agency and providing evidence establishing that the conditions that gave rise to the appearance of a violation have been resolved and that there is sufficient evidence for the Agency to have confidence that future entries will be in compliance with the FFDCA. Generally, a minimum of five consecutive non-violative commercial shipments, as demonstrated by providing the FDA with acceptable reports of private laboratory analyses, as well as an effective, detailed approach addressing the conditions that gave rise to the appearance of the violation is provided to support the corrective actions and removal of a grower's, manufacturer's, or shipper's product from DWPE.

Regulatory Monitoring Program Sampling Design

The goal of the FDA's pesticide residue monitoring program is to carry out selective monitoring of human and animal foods for consumer protection. The FDA samples are primarily of the surveillance type, meaning there is no specific prior knowledge or evidence that a particular food shipment contains illegal residues. However, the FDA's monitoring is not random or statistically designed; rather, emphasis is given to the sampling of certain commodities. Commodity choice is based upon multiple factors, including:

- most frequently consumed or imported;
- commodities and places of origin with a history of violations;
- size of shipments;
- analysis of past problem areas;
- commodity/pesticide findings from state, USDA, and FDA monitoring;
- foreign pesticide usage data and regional intelligence on pesticide use;
- dietary significance of the food;
- volume and product value of individual commodities of domestic food produced and entered into interstate commerce and of import food offered for entry into the United States;
- origin of imported food; and
- chemical characteristics and toxicity of the pesticide(s) used.

One important consideration when designing the FDA pesticide residue monitoring program for human foods is the distinction between domestic and import commodities. Historically, the violation rate of import samples is 3-5 times higher than the rate for domestic samples. For example, between FY 2014-2020, the violation rate for domestic samples ranged from 0.9-3.8%, whereas the rate for import samples ranged from 9.4-12.9%. Because the violation rate of import samples is higher than for domestic samples, the FDA allocates more resources towards testing import compared with domestic commodities. Typically, import commodities comprise about 70% of all samples analyzed each year. In FY 2021, due to impacts on FDA surveillance and monitoring activities during the COVID-19 pandemic, about 78% of all samples were imports.

In addition to increased sampling of import commodities, the FDA targets specific commodities and countries that might warrant special attention based upon historically high violation rates and trends. The FDA also utilizes available foreign pesticide usage data and data from the USDA's Pesticide Data Program (PDP), a statistically representative survey of pesticide residues in selected food commodities, to develop its sampling program (https://www.ams.usda.gov/datasets/pdp).

Other federal agencies and several states have their own monitoring programs for pesticides. Through collaboration and agreements, they provide information and data on violative samples found in domestic commerce to the FDA (see Cooperative Arrangements and International Activities section). The FDA leverages these data to focus its resources where they are most efficiently and effectively used.

Sampling levels and bias for particular import or domestic commodities can vary significantly from year to year. Pesticide applications are modified in response to

changing weather patterns, new or re-emergent pests, or developed resistance to pesticides. Targeted commodities may not be the largest imports by volume from a particular country. A high violation rate for a targeted commodity does not mean that a country's overall violation rate for all commodities is high; rather, it affirms the FDA's sampling design to select commodities and production sources that are likely to be higher risk.

The FDA's current pesticide sampling program, coupled with broad-based enforcement strategies for imports, allows the FDA to achieve the program's main objective of consumer protection across a wide range of commodities. The FDA has conducted statistically-based and resource-intensive incidence and level monitoring studies of four significant foods.[3,4] The FDA's TDS program and the USDA PDP program collect incidence and level monitoring data, which support the pesticide regulatory monitoring program.

Focused Sampling

In addition to samples collected for routine regulatory monitoring, the FDA may conduct special "focused sampling" assignments to target specific food commodities for analysis. Focused sampling is generally used to follow up on suspected problem areas or to acquire residue data on selected commodities and/or selected pesticides, not usually or previously covered during regulatory monitoring. Typically, samples collected for a focused sampling assignment are analyzed using routine pesticide procedures; however, in some cases the samples are analyzed for targeted residues of interest.

Animal Food

In addition to monitoring food for human consumption, the FDA samples and analyzes domestic and imported animal foods for pesticide chemical residues. The FDA's Center for Veterinary Medicine (CVM) directs this portion of the Agency's surveillance program via its Animal Food Contaminants Program. CVM's program focuses on animal food that is consumed by livestock and poultry animals that ultimately become or produce food for human consumption, although some pet food samples are also included.

Analytical Methods and Pesticide Coverage

To analyze large numbers of samples with unknown pesticide treatment history, the FDA uses multi-residue methods (MRMs) capable of simultaneously determining many different pesticide chemical residues. These MRMs are also able to detect many metabolites, impurities, and alteration products of pesticides, as well as selected industrial chemicals. In addition, the FDA uses selective residue methods (SRMs) that target specific pesticides. SRMs are sometimes needed to analyze pesticides that are not adequately extracted or detected using standard MRMs or to target specific pesticide/commodity combinations. The FDA pesticide SRMs are optimized to determine one or several specific pesticide chemical residues in foods. They are more resource intensive and therefore employed more judiciously. The complete list of pesticides analyzed in FY 2021 is provided in Appendix A.

The FDA pesticide methods can detect approximately 75 percent of the pesticides with current or revoked EPA tolerances in Title 40 of the U.S. Code of Federal Regulations (CFR) part 180, as well as nearly 400 other pesticide chemical residues that have no EPA

tolerance.[†] By testing for pesticides without EPA tolerances, the FDA provides protection against pesticides that do not have EPA approval. The number of compounds (pesticides and industrial chemicals) in the analytical scope decreased slightly compared to FY 2020 (740 total compounds in FY 2021 vs. 747 in FY 2020). Pesticides and industrial chemicals that are obsolete or detected rarely were removed from the scope as part of the FDA's continuing modernization process. The FDA continues to review new pesticides registered by EPA for possible addition to the FDA's testing scope but acknowledges that some pesticides with EPA-established tolerances are not part of the current FDA testing scope, and the FDA does not know the extent to which exposure to these pesticides may occur in the foods that FDA regulates.

The lower limit of residue measurement in FDA's determination of a specific pesticide is well below typical tolerance levels, which range from 0.01 to over 100 parts per million (ppm). Most pesticides analyzed can be quantified at the FDA's default limit of quantitation (LOQ) of 0.01 ppm.[5] Residue levels detected above the limit of detection (LOD) but below the LOQ are designated as "trace" values.

The FDA conducts ongoing research to update its pesticide residue monitoring program. This research includes testing the behavior of new or previously untested pesticides through existing analytical methods, as well as developing new methods to improve efficiencies and detection capabilities. Newer extraction procedures and more sensitive detection techniques have increasingly replaced older methods, allowing for more efficiency in pesticide testing.

FDA Total Diet Study

An important complement to the FDA's regulatory pesticide residue monitoring program is TDS. Through TDS the FDA monitors levels of pesticide chemicals, toxic and nutritional elements, industrial chemicals, and radionuclides in foods representing the totality of the American diet. TDS is distinct from the FDA's regulatory pesticide residue monitoring program and is focused on information gathering rather than enforcement. Regulatory monitoring determines pesticide chemical residues primarily in raw commodities, whereas TDS monitors foods prepared table-ready for consumption. TDS uses a modified version of the regulatory program extraction method that is too time-intensive for rapid regulatory follow-up, but it allows detection of pesticides at levels 10-100 times lower than in the regulatory monitoring program, i.e., residue levels as low as 0.1 parts per billion (ppb). Data from TDS can be used to calculate exposures to pesticides, nutrients, and contaminants from the U.S. diet, and to suggest potential areas of focus for the FDA's food safety and nutrition programs. TDS pesticide results through FY 2017 were included in the pesticide residue monitoring program annual reports. TDS pesticide results from FY 2018 on will be posted separately on the FDA's TDS website, along with additional information about the history and design of the TDS.

[†] Additional information on EPA tolerances for pesticide ingredients can be found at: https://www.epa.gov/pesticide-tolerances/how-search-tolerances-pesticide-ingredients-code-federal-regulations (accessed September 15, 2023).

Cooperative Agreements and International Activities

The FDA collaborates with local, state, federal, and international authorities, leveraging their programs and capacities to maximize the effectiveness of its pesticide program. For example, the FDA and USDA have a Memorandum of Understanding (MOU) in which the USDA alerts the FDA monthly of presumptive tolerance violations they find in the PDP. The FDA uses this information when designing the annual pesticide residue monitoring program, and for directing immediate sample collection efforts, as appropriate.

FDA-State Cooperation

The FDA field offices interact with their counterparts in many states to enhance the effectiveness of the Agency's pesticide residue monitoring program. Partnership agreements and MOUs have been established between the FDA and many state agencies. These agreements provide for more efficient residue monitoring by both parties by coordinating efforts, broadening coverage, and eliminating duplication of effort. These agreements are specific to each state and take into account available resources. The agreements stipulate how the FDA and the state will jointly plan work for collecting and analyzing samples, sharing data, and enforcing compliance follow-up responsibilities for individual commodities of domestic and import products.

International Activities

As an agency of the U.S. government, the FDA is subject to the obligations placed on the World Trade Organization (WTO) members by the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement). The FDA's enforcement of pesticide residue tolerances and monitoring activities falls under the definition of sanitary measures within the SPS Agreement. The FDA's obligations under this agreement include the requirement that its measures are based on an assessment, as appropriate to the circumstances, of the risk to human and animal life or health, and on international standards except when a more stringent standard can be scientifically supported. The measures must also be applied equally to domestic and import products unless there is scientifically based justification for doing otherwise. Similarly, the FDA is subject to obligations arising from several bilateral and multilateral free trade agreements with U.S. trading partners that contain provisions on sanitary measures that are consistent with the provisions of the SPS Agreement.

The FDA pesticide residue monitoring activities, for domestic and imported products, are a part of the Agency's overall food safety programs and are in keeping with these international obligations. Additionally, arrangements the FDA makes with other countries with respect to food safety programs, and the activities that the FDA carries out internationally with respect to food safety, can also affect how the agency's pesticide residue monitoring is conducted.

The FDA maintains a number of cooperative arrangements with counterpart agencies in foreign governments, including MOUs and Confidentiality Commitments. These arrangements most often contain information-sharing provisions that encompass the ability to share analytical findings about pesticide residues, while protecting any confidential information from external disclosure. Several of these MOUs have specific provisions

relating to pesticide residue information sharing or cooperative efforts relating to pesticide residues.

The FDA participates regularly in meetings with food safety regulatory agencies of foreign governments in a variety of settings, including bilateral and multilateral fora and in formal and informal technical and policy meetings. The FDA carries out bilateral discussions on food safety with our regulatory partners from around the world; pesticide control programs and pesticide residue issues can be subjects for discussion at these meetings. Multilateral fora in which the FDA participates include the Food Safety Cooperation Forum (FSCF) of the Asia-Pacific Economic Cooperation (APEC), which promotes regulatory cooperation in food safety including information sharing on pesticide MRLs.

The FDA also participates in the work of international standards-setting organizations, including that of the Codex Alimentarius Commission (Codex). Within Codex, the FDA is an active participant in the work of the Codex Committee on Pesticide Residues.

Results and Discussion

This report discusses results of the FY 2021 FDA pesticide residue monitoring program. Additionally, the report examines data to evaluate import products that may warrant special attention.

In FY 2021, the FDA analyzed 1,447 samples under the regulatory monitoring program, of which 1,367 were human foods and 80 were animal foods. Results for the testing of human and animal foods are reviewed under separate headings, "Regulatory Monitoring of Human Foods" and "Regulatory Monitoring of Animal Foods." Sampling and analytical data were obtained from the FDA Field Accomplishment and Compliance Tracking System (FACTS) database. Results in this report represent samples with a collection date occurring in FY 2021.

Sample collection in FY 2021 was significantly impacted by the Covid-19 pandemic, as was the FY 2020 collection. This resulted in approximately 68% fewer samples collected for the human food pesticide monitoring program and 78% fewer for the animal food pesticide monitoring program in FY 2021 compared with FY 2019. In addition, more import samples were collected in FY 2021 relative to domestic samples. Domestic samples were not collected for the "Domestically Produced Animal Derived Foods" assignment, conducted in recent years. Sample collection and analysis is expected to increase in FY 2022.

Regulatory Monitoring of Human Foods

The 1,367 human foods analyzed in FY 2021 include 300 domestic samples and 1,067 import samples. Results for the domestic samples are tabulated in Appendix B, "Analysis of Domestic Human Foods by Commodity Group in FY 2021," and results for the import samples are tabulated in Appendix C, "Analysis of Import Human Foods by Commodity Group in FY 2021." Each appendix includes information on the total number of samples analyzed, the number and percentage of samples with no residues detected, and the number and percentage of violative samples including the nature of the violation (over-tolerance

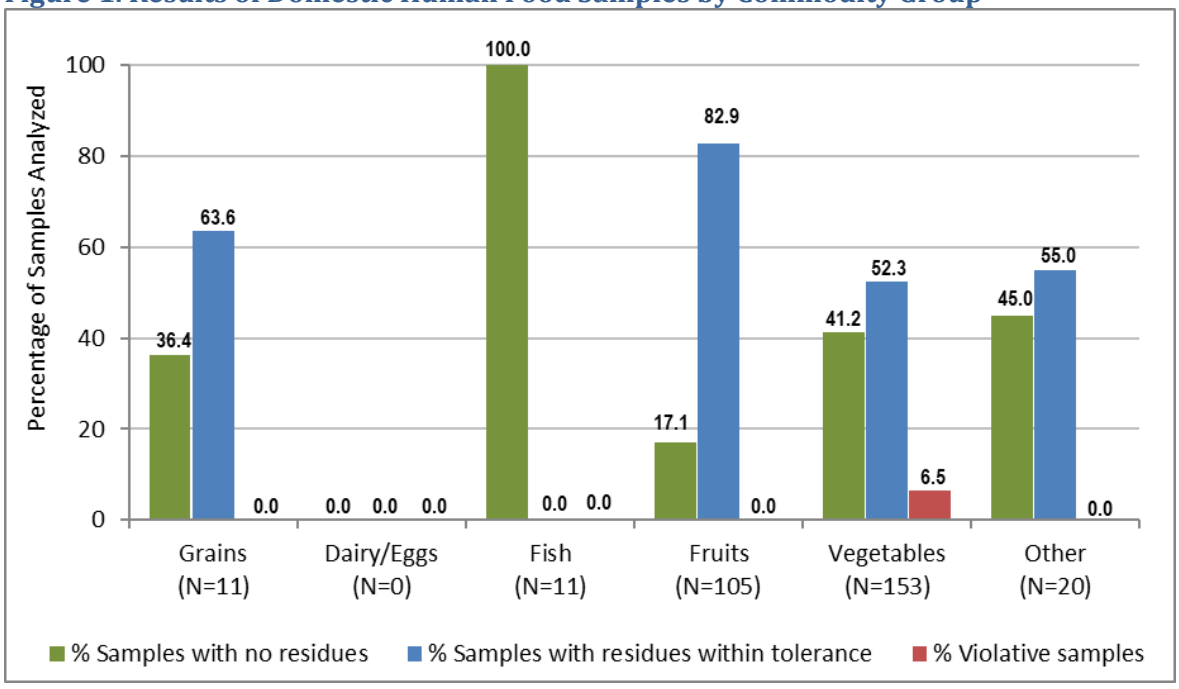
vs. no-tolerance). Results are summarized for all samples analyzed, by commodity groups and by subgroups.

Results

Of the 300 domestic samples analyzed in FY 2021, 96.7% were in compliance and 35.0% had no detectable residues (Appendix B). Samples collected under the domestic commodity groups "Fruits" and "Vegetables" accounted for the majority (86.0%) of domestic samples.

Figure 1 summarizes the number of samples analyzed and the residue findings in domestic samples by commodity groups. For the grains and grain products commodity group, no residues were detected in 36.4% of the 11 samples analyzed and no samples contained violative residues. No samples were collected in the milk/dairy products/eggs commodity group. For the fish/shellfish/other aquatic products commodity group, no residues were detected in any of the 11 samples analyzed. In the fruits commodity group, no residues were found in 17.1% of the 105 samples analyzed and no samples contained violative residues. For the vegetables commodity group, no residues were found in 41.2% of the 153 samples analyzed and 10 samples (6.5%) contained violative residues. In the commodity group of other food products, consisting largely of nuts, no residues were found in 45.0% of the 20 samples analyzed and no samples contained violative residues.

Figure 1. Results of Domestic Human Food Samples by Commodity Group



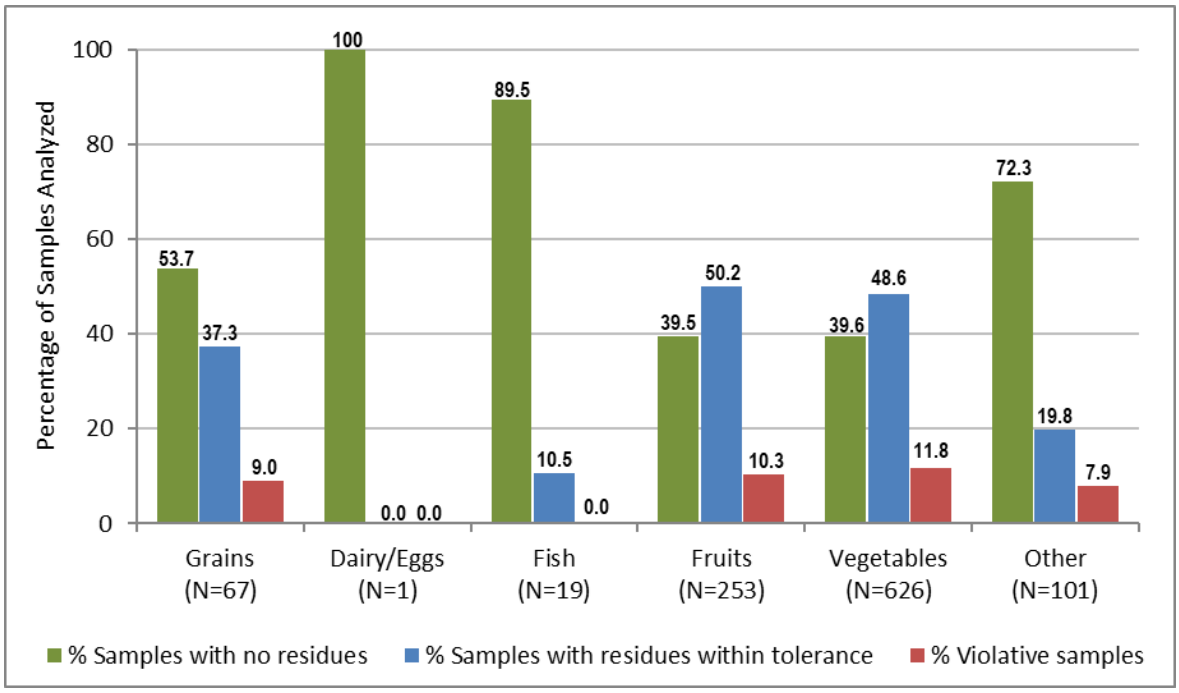
N = Number of samples analyzed for commodity group

Of the 1,067 import samples analyzed in FY 2021, 89.3% were in compliance and 44.5% had no detectable residues (Appendix C). Fruits and vegetables accounted for the majority (82.4%) of import samples.

Figure 2 summarizes the number of samples analyzed and the residue findings in import

samples by commodity groups. In the import grains and grain products commodity group, 53.7% of the 67 samples analyzed had no detectable residues and 6 samples (9.0%) contained violative residues. For the import milk/dairy products/eggs commodity group, 1 egg sample was analyzed and no residues were detected. For the import fish/shellfish/other aquatic products commodity group, 89.5% of the 19 samples analyzed had no detectable residues and no samples contained violative residues. For the import fruit commodity group, 39.5% of the 253 samples analyzed had no detectable residues and 26 samples (10.3%) contained violative residues. For the import vegetables commodity group samples, 39.6% of the 626 samples had no detectable residues and 74 samples (11.8%) had violative residues. In the commodity group of other import food products, 72.3% of the 101 samples analyzed had no residues detected and 8 samples (7.9%) had violative residues.

Figure 2. Results of Import Human Food Samples by Commodity Group

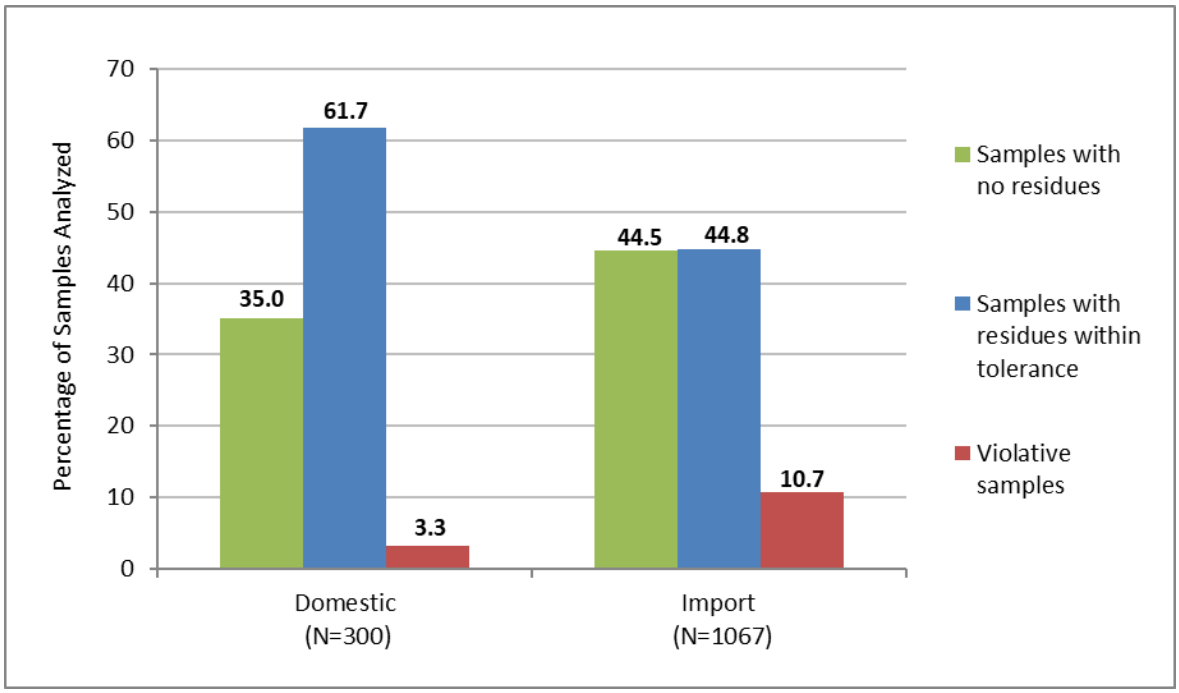


N = Number of samples analyzed for commodity group

Overall Results for Domestic and Import Human Food Samples

In total, 300 domestic and 1,067 import human food samples were collected and analyzed for the pesticides listed in Appendix A. No residues were found in 35.0% of domestic samples and 44.5% of import samples (Figure 3). Violative residues were found in 3.3% of the domestic samples and 10.7% of the import samples. The violation rates for both domestic and import samples in FY 2021 were consistent with recent years; between FY 2014-2020, the domestic violation rate ranged from 0.9-3.8% and the import violation rate ranged from 9.4 to 12.9%.

Figure 3. Summary of Results of Domestic and Import Human Food Samples



N = Number of samples analyzed for commodity group

For all commodity groups, the violation rate was higher for import samples. For example, 9.0% of import grain samples were violative; however, none of the domestic grain samples were violative. Similarly, 10.3% of the import fruit samples were violative compared with none of the domestic fruit samples, and 11.8% of import vegetable samples were violative, whereas 6.5% of domestic vegetable samples were violative. In the commodity group of other food products, the violation rate was 7.9% for import samples compared with no violations for domestic samples.

Of the 10 domestic violative samples, 10 contained pesticide chemical residues that have no EPA tolerance, i.e., no-tolerance violations, and 2 contained pesticide chemical residues that exceeded an EPA tolerance, i.e., over-tolerance violations. Two samples had both no-tolerance and over-tolerance violations for different pesticides.

Of the 114 import violative samples, 100 had no-tolerance violations and 27 had over-tolerance violations; 13 samples had both no-tolerance and over-tolerance violations for different pesticides contained in the same sample.

Geographic Coverage

Domestic: A total of 300 domestic samples were collected from 26 states. Table 1 lists the number of domestic samples from each state and territory, in descending order. No domestic samples were collected from the states of Alabama, Alaska, Arizona, Arkansas, Delaware, Georgia, Idaho, Illinois, Indiana, Maryland, Mississippi, Missouri, Montana, New Hampshire, North Carolina, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Utah, Vermont, Virginia, Wyoming, or the District of Columbia.

Table 1. Domestic Samples Collected and Analyzed per State

State	Samples (N)
California	109
New York	47
Kansas	29
Florida	19
Washington	15
Iowa	13
Texas	11
Oregon	7
Ohio	6
Massachusetts	6
New Jersey	6
Colorado	5
Hawaii	4
Connecticut	3
Louisiana	3
Nevada	3
North Dakota	2
Minnesota	2
West Virginia	2
New Mexico	2
Maine	1
Kentucky	1
Nebraska	1
Tennessee	1
Wisconsin	1
Michigan	1

Imports: A total of 1,067 import samples were collected representing food shipments from 66 countries/economies. Table 2 lists the number of samples and names of countries/economies from which ten or more samples were collected, in order of decreasing number of samples. Table 2a lists the countries/economies that had fewer than ten samples collected, in alphabetical order.

Table 2. Import Samples per Country/Economy of Origin for Which Ten or More Samples Were Collected and Analyzed

Country/Economy	Samples (N)
Mexico	437
Canada	132
China	82
India	39
Turkey	37
United States*	30
Dominican Republic	28
Pakistan	23
Peru	22
Vietnam	17
Chile	15
Yemen	14
Afghanistan	13
Myanmar	10
Thailand	10

*Indicates import samples collected while in interstate commerce.

Table 2a. Countries/Economies of Origin from Which Fewer Than Ten Samples Were Collected and Analyzed

Algeria	Ghana	New Zealand
Argentina	Greece	Norway
Austria	Guatemala	Philippines
Bangladesh	Honduras	Poland
Belarus	Iceland	Saudi Arabia
Belgium	Indonesia	Serbia
Brazil	Iraq	South Africa
Bulgaria	Israel	Spain
Cameroon	Italy	Sri Lanka
Colombia	Ivory Coast	Syrian Arab Republic
Costa Rica	Japan	Taiwan
Czech Republic	Kenya	Togo
Ecuador	Korea, Republic Of (South)	Tunisia
Egypt	Lebanon	Turkmenistan
Ethiopia	Madagascar	Ukraine
France	Morocco	United Kingdom
Germany	Netherlands	Uzbekistan

Pesticides Detected

In FY 2021, the FDA pesticide methods could detect the 740 pesticides and industrial chemicals listed in Appendix A. Of these chemicals, residues of 172 different pesticides were detected in the samples analyzed. They are listed in Table 3 in order of frequency of detection along with the number of samples in which they were found. The number of pesticides in the analytical scope decreased slightly compared to FY 2020 (747 in FY 2020). Pesticides that are obsolete or detected rarely, as well as some industrial chemicals, were removed from the scope as part of the FDA's commitment to continual improvement. No new pesticides were detected in FY 2021 that had not been detected previously by the FDA regulatory pesticide monitoring program.

Table 3. Pesticides Found in Human Foods in FY 2021 Listed in Order of Frequency

Pesticide	Samples (N)
Imidacloprid	128
Azoxystrobin	100
Boscalid	88
Cypermethrin	87
Pyraclostrobin	76
Fludioxonil	68
Thiamethoxam	68
Chlorpyrifos	67
Acetamiprid	65
Thiabendazole	57
Chlorantraniliprole	56
Fluopyram	54
Metalaxyl	53
Bifenthrin	52
Lambda-cyhalothrin	50
Tebuconazole	47
Propamocarb	44
Cyprodinil	43
Clothianidin	42
Carbendazim[†]	41
Linuron	41
Difenoconazole	38
Imazalil	34
Permethrin	34
Myclobutanil	33
Pyrimethanil	32
Malathion	31
Flonicamid	30
Piperonyl butoxide	28
Glyphosate	24
Methamidophos	24
Propiconazole	23
Dimethomorph	22
Cyfluthrin	21
Fluxapyroxad	21
Methoxyfenozide	21
Thiophanate-methyl	21
Fenpropathrin	20

Pesticide	Samples (N)
Chlorothalonil	19
Flupyradifurone	19
Captan	17
Fluopicolide	17
Spirotetramat	17
Iprodione	16
Trifloxystrobin	16
Acephate	15
Buprofezin	15
Chlorfenapyr	15
Deltamethrin	15
Dinotefuran	15
Thiacloprid	15
Cyantraniliprole	14
Novaluron	14
Spinetoram	14
Bifenazate	13
Indoxacarb	13
Chlorpropham	12
Dimethoate	12
Flutriafol	12
Methomyl	12
Spiromesifen	12
Mandipropamid	11
Spinosad	11
Carbaryl	10
Diflubenzuron	10
Metrafenone	10
Spirodiclofen	10
Famoxadone	9
Quinoxyfen	9
Cyromazine	8
Fenvalerate	8
Pyriproxyfen	8
Ametoctradin	7
Cyazofamid	7
DCPA	7
Diazinon	7

Pesticide	Samples (N)
Fenamidone	7
Fenpyroximate, e-	7
Sulfoxaflor	7
2,4-D	6
Diafenthiuron	6
Fenhexamid	6
Oxamyl	6
Dichlorvos	5
Fipronil	5
Flubendiamide	5
Haloxyfop	5
Monocrotophos	5
Penthiopyrad	5
Profenofos	5
Bromopropylate	4
Chlorpyrifos methyl	4
Etofenprox	4
Fenazaquin	4
Fenbuconazole	4
Fenbutatin oxide	4
Hexythiazox	4
Imazamox	4
Oxathiapiprolin	4
Phenylphenol, o-	4
Prometryn	4
Propargite	4
Pyridaben	4
Pyridalyl	4
Tricyclazole	4
Clofentezine	3
Cyflumetofen	3
Dicloran	3
Emamectin benzoate	3
Etoxazole	3
Flusilazole	3
Fosthiazate	3
Methoprene	3
MGK 264	3
Penconazole	3

Pesticide	Samples (N)
Pirimiphos methyl	3
Tetraconazole	3
Thiodicarb	3
Tolfenpyrad	3
Triflumizole	3
2,6-DIPN	2
Abamectin	2
Carbofuran	2
Cyflufenamid	2
Cyproconazole	2
Diphenylamine	2
Esfenvalerate	2
Ethion	2
Ethoxyquin	2
Fenitrothion	2
Fluoxastrobin	2
Isoprothiolane	2
Kresoxim-methyl	2
Metaflumizone	2
Pendimethalin	2
Prochloraz	2
Procymidone	2
Pyriofenone	2
Quinclorac	2
Acequinocyl	1
Atrazine	1
Benzovindiflupyr	1
Bupirimate	1
Cymoxanil	1
DDT	1
Dodine	1
Epoxiconazole	1
Ethoprop	1
Fenamiphos	1
Fenobucarb	1
Fenpropimorph	1
Folpet	1
Formetanate HCl	1
Glufosinate	1

Pesticide	Samples (N)
Hexaconazole	1
Imazethapyr	1
Isofetamid	1
Ivermectin	1
Mepanipyrim	1
Metolachlor	1
Metribuzin	1
Penflufen	1
Phosalone	1

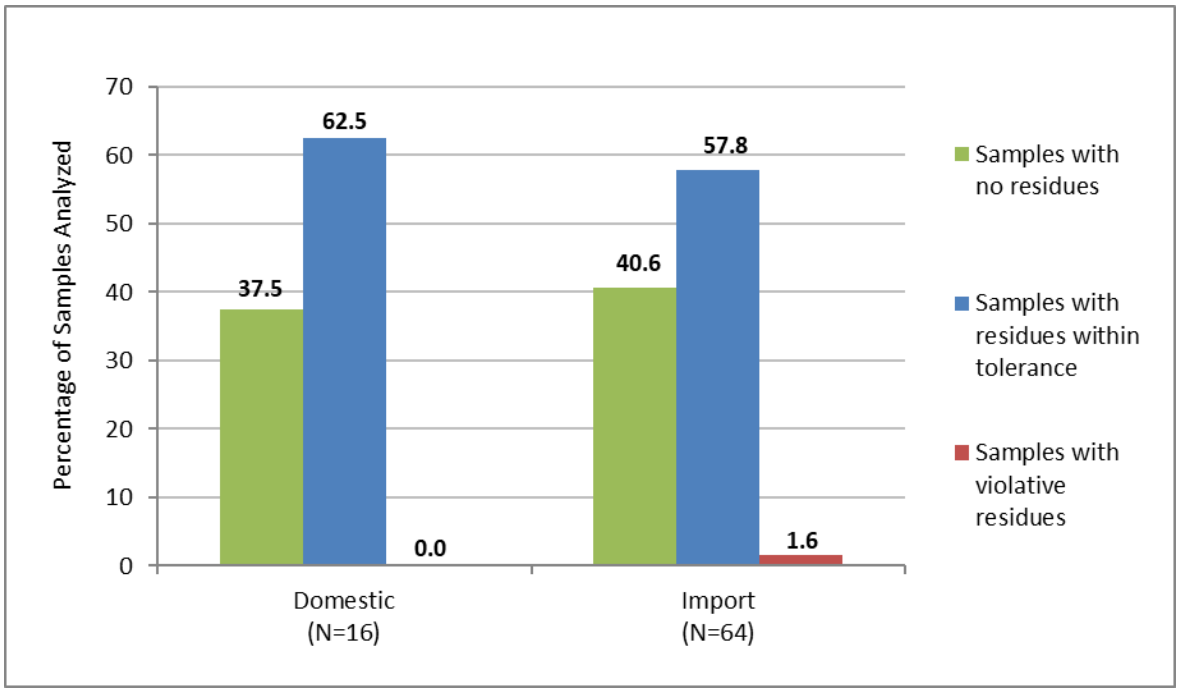
Pesticide	Samples (N)
Pronamide	1
Quintozene	1
Resmethrin	1
Rotenone	1
Sedaxane	1
Terbuthylazine	1
Triazophos	1
Triflumuron	1
Trifluralin	1

[†]Carbendazim is both a fungicide and a degradant of thiophanate methyl; it was reported under the category of thiophanate methyl in the 2015 and 2016 pesticide residue monitoring reports.

Regulatory Monitoring of Animal Foods

In FY 2021, the FDA analyzed 80 animal food samples for pesticides. Figure 4 summarizes the number of samples analyzed and residue findings in domestic and import samples.

Figure 4. Summary of Results of Domestic and Import Animal Food Samples



N = Number of samples analyzed for commodity group

Of the 80 animal food samples, 16 samples were domestic and 64 samples were imports. No residues were found in 6 (37.5%) of the 16 domestic samples, and none of the samples with residue detections were violative. Of the 64 import samples, 26 (40.6%) contained no residues and 1 sample (1.6%) was violative.

The violation rate of 0% for domestic animal foods in FY 2021 is the same as in FY 2020 and is below violation rates for FY 2014-2019, i.e., 0.8-3.8%. The violation rate of 1.6% for import animal foods is below violation rates for FY 2014-2020; i.e., 3.1-5.6%. As the COVID-19 pandemic continued to affect sampling efforts in FY 2021, the sample numbers remain very low and only limited conclusions can be drawn from the results.

Table 4 summarizes residue findings for eight different animal food categories.

Table 4. Summary of Animal Foods by Commodity Type

Commodity Type	Samples Analyzed N	Without Residues N (%)	Violative Samples N (%)
Totals – All Samples	**80**	**32 (40)**	**1 (1.3)**
Whole and Ground Grains/Seeds	25	14 (56)	0 (0)
Mixed Livestock Food Rations	7	1 (14.3)	0 (0)
Medicated Livestock Food Rations	7	2 (28.6)	0 (0)
Plant Products/Byproducts	35	10 (28.6)	1 (2.9)
Hay and Silage	1	1 (100)	0 (0)
Animal Byproducts	2	1 (50)	0 (0)
Pet Food/Treats	1	1 (100)	0 (0)
Other Animal Food Ingredients	2	2 (100)	0 (0)

[†]Percentage of the number of samples analyzed per commodity type.

Commodities commonly used to feed livestock that produce food for human consumption, i.e., Whole and Ground Grains/Seeds, Mixed Livestock Food Rations, Medicated Livestock Food Rations, Plant Products/Byproducts, and Hay and Silage, comprised the majority (93.8%) of the samples analyzed. Of these 75 samples, 1 (1.3%) was violative.

Geographic Coverage

Domestic: A total of 16 domestic animal food samples were collected from 5 states. Table 5 lists the number of domestic samples from each state in descending order. No domestic samples were collected from the remaining U.S. states or its territories.

Table 5. Domestic Animal Food Samples Collected and Analyzed per State

State/Territory	Samples (N)
California	10
Wisconsin	2
Kentucky	2
New York	1
Arkansas	1

Imports: A total of 64 import samples were collected representing animal food samples from 7 countries. Table 6 lists the number of samples and names of the countries of origin in order of decreasing number of samples.

Table 6. Import Animal Food Samples Collected and Analyzed per Country of Origin

Country	Samples (N)
Canada	51
India	6
United States*	3
Belgium	1
China	1
France	1
Norway	1

* Indicates import samples collected while in interstate commerce

Pesticides Detected

In FY 2021, residues of 44 different pesticides were found in the 80 animal food samples analyzed. They are listed in Table 7 in decreasing order of detection along with the number of samples in which they were found.

All animal foods were analyzed for 740 different pesticides and industrial chemicals using the FDA pesticide MRMs (Appendix A). One violation was observed in the 80 samples, a no-tolerance violation of chlorpropham in a sample of carrot powder from India. The glyphosate SRM was used to test 38 animal food samples (12 domestic and 26 import) for glyphosate and glufosinate. Glyphosate was detected in 18 samples, (3 domestic and 15 import) but none were violative. The acid herbicides SRM was used to test 40 samples (3 domestic and 37 import) for the presence of acid herbicides. Most of the samples (95.0%) had no acid herbicide residues; 2 import samples had detectable levels of 2,4-D but were not violative.

Although significantly fewer samples were collected than prior years due to the COVID-19 pandemic, the number of violative samples was similar to past years.

Table 7. Pesticides Found in Animal Foods in FY 2021 Listed in Order of Frequency

Pesticide	Samples (N)
Glyphosate	18
Malathion	12
Piperonyl butoxide	6
Ethoxyquin	5
Chlorpropham	4
Difenoconazole	4
Azoxystrobin	3
Boscalid	3
Imidacloprid	3
Propiconazole	3
2,4-D	2
Carbendazim	2
Diflubenzuron	2
Methoxyfenozide	2
Permethrin	2
Tebuconazole	2
Thiabendazole	2
Ametoctradin	1
Bifenthrin	1
Buprofezin	1
Captan	1
Chlorantraniliprole	1

Pesticide	Samples (N)
Cyprodinil	1
DDT	1
Deltamethrin	1
Diafenthiuron	1
Fenbuconazole	1
Fenhexamid	1
Flonicamid	1
Fludioxonil	1
Fluxapyroxad	1
Glufosinate	1
Iprodione	1
Linuron	1
Metalaxyl	1
Metconazole	1
Methoprene	1
Metolachlor	1
Metribuzin	1
Pendimethalin	1
Penthiopyrad	1
Pyraclostrobin	1
Thiamethoxam	1
Thiophanate-methyl	1

Focused Sampling

No focused sampling assignments were conducted in FY 2021 due to Covid-19 pandemic-related resource constraints.

Imported Products That May Warrant Special Attention

The design of the FDA pesticide program focuses on products that have a history of violations or are suspected of violations, based on information such as reports from other agencies and pesticide usage data. Historically, the violation rate for import foods is higher than for domestic foods; results from FY 2021 continue that trend.[7] The violation rate for import foods (10.7%) was over 3 times higher than the rate for domestic foods (3.3%). The majority of the violations for import commodities are no-tolerance violations, with approximately 82% of the violative residues < 0.1 ppm.

The following criteria were applied to the FY 2021 data to select import commodities that may warrant special attention:

- commodities with at least 20 samples analyzed OR with a minimum of 3 violations, and
- a violation rate of 10% or higher.

Table 8 lists the import commodities analyzed in FY 2021 that meet the above criteria. The commodities are listed alphabetically and include the total number of samples analyzed and violation rate per commodity.

Table 8. Import Commodities That May Warrant Special Attention

Commodity†	Samples Analyzed (N)	Violation Rate (%)
Carrots	24	16.7
Cilantro	37	37.8
Figs	6	83.3
Grapes	30	10.0
Mushrooms and fungi*	22	13.6
Olives*	8	50.0
Onions, leeks, scallions, shallots*	46	26.1
Peppers, hot*	66	16.7
Prickly pear	7	42.9
Radishes*	18	16.7
Rice*	31	12.9
Squash	20	10.0
String beans*	26	11.5

†Data listed for the commodities in this table are based upon specific product definitions and may not be directly comparable to product summary subcategories listed in Appendix C.

*Commodity was on the FY 2020 table of import commodities warranting special attention.

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Appendices

Appendix A lists the 740 pesticides and industrial chemicals analyzed using FDA methods in FY 2021. The MRM method is used to analyze the majority of pesticides (709), and two SRMs were used to analyze (1) glyphosate, glufosinate, and their degradation products (glyphosate SRM) and (2) 27 selected acid herbicides (acid herbicides SRM). In addition to these chemicals, FDA analytical procedures detect other metabolites and isomers associated with the pesticides listed in Appendix A.

All residue findings for human foods are summarized in Appendices B (domestic) and C (import). In FY 2021, 79 different domestic human food commodities and 230 different import human food commodities were tested. In both appendices, all commodities have been assigned to the same six commodity groups; however, no domestic milk, dairy products, or eggs were analyzed in FY 2021:

Grains/Grain Products
Milk/Dairy Products/Eggs
Fish/Shellfish/Other Aquatic Products
Fruits
Vegetables
Other Food Products

Commodities are further categorized within each commodity group. For example, the subcategories for domestic commodities listed under the "Grains and Grain Products" commodity group in Appendix B include:

Barley and barley products
Corn and corn products
Oats and oat products
Rice and rice products
Soybeans and soybean products
Wheat and wheat products
Other grains and grain products

Each of these subcategories includes commodities derived from a single agricultural commodity. For example, the subcategory "Wheat and wheat products" includes commodities composed exclusively, or almost exclusively, from wheat, such as whole wheat grain, milled wheat, wheat flour, enriched wheat flour, wheat germ, wheat malt, wheat bran, and wheat gluten.

The subcategories within each commodity group may differ between the appendices for domestic and import commodities. This is because the numbers and kinds of individual commodities available are different for domestic and import commodities. For example, under the "Fruit" commodity group, 36 subcategories are listed for the import samples in Appendix C, but only 20 subcategories are listed for the domestic samples in Appendix B. The additional import "Fruit" subcategories are mostly for fruits not available domestically.

Appendix A. Pesticides and Industrial Chemicals Analyzed by FDA Pesticide Methods in FY 2021

2,4,5-T methyl ester
2,4-D[1]
2,4-D methyl ester
2,4-DB[1]
2,4-DB methyl ester
2,6-DIPN
3,4-Dichloroaniline[3]
4-CPA[1]
Abamectin
Acephate
Acequinocyl
Acetamiprid
Acetochlor
Acibenzolar-S-methyl
Acifluorfen[1]
Acifluorfen methyl ester
Aclonifen
Acrinathrin
Akton
Alachlor
Aldicarb
Aldrin
Allethrin
Allidochlor
Ametoctradin
Ametryn
Amicarbazone
Amidithion
Amidoflumet
Aminocarb
Aminopyralid[1]
Amisulbrom
Amitraz
Ancymidol
Anilazine
Anilofos
Aramite
Aspon
Atraton
Atrazine
Azaconazole
Azamethiphos
Azinphos ethyl
Azinphos-methyl
Aziprotryne
Azoxystrobin
BAM[4]
Beflubutamid
Benalaxyl
Bendiocarb
Benfluralin
Benfuracarb
Benfuresate
Benodanil
Benoxacor
Bentazon
Benthiavalicarb-isopropyl
Benzovindiflupyr
Benzoximate
Benzoylprop ethyl
BHC
Bicyclopyrone
Bifenazate
Bifenox
Bifenthrin
Binapacryl
Biphenyl
Bistrifluron
Bitertanol
Bixafen
Boscalid
Bromacil
Bromfenvinphos ethyl
Bromfenvinphos methyl
Bromobutide
Bromocyclen
Bromophos
Bromophos-ethyl
Bromopropylate
Bromoxynil[1]
Bromoxynil octanoate
Bromuconazole
Bufencarb
Bupirimate
Buprofezin
Butachlor
Butafenacil
Butamifos
Butralin
Butylate
Cadusafos
Cafenstrole
Captafol
Captan
Carbaryl
Carbendazim[5]
Carbetamide
Carbofuran
Carbophenothion
Carbosulfan
Carboxin
Carfentrazone ethyl ester
Carpropamid
Chlorantraniliprole
Chlorbenside
Chlorbicyclen
Chlorbromuron
Chlorbufam
Chlordane
Chlordecone
Chlordimeform
Chlorethoxyfos
Chlorfenapyr
Chlorfenethol
Chlorfenvinphos
Chlorfenvinphos methyl
Chlorfluazuron
Chlorimuron-ethyl
Chlormephos
Chlornitrofen
Chlorobenzilate
Chloroneb
Chloropropylate
Chlorothalonil
Chlorotoluron
Chloroxuron
Chlorpropham
Chlorpyrifos
Chlorpyrifos methyl
Chlorthiamid
Chlorthiophos
Chlozolinate
Chromafenozide
Cinidon-ethyl
Clethodim
Clodinafop-propargyl
Clofentezine
Clomazone
Clopyralid[1]
Cloquintocet-mexyl
Clothianidin
Coumaphos
Crimidine
Crotoxyphos
Crufomate
Cumyluron
Cyanazine
Cyanofenphos
Cyanophos
Cyantraniliprole
Cyazofamid
Cyclafuramid
Cycloate

Cycloxydime
Cycluron
Cyenopyrafen
Cyflufenamid
Cyflumetofen
Cyfluthrin
Cyhalofop butyl ester
Cymiazole
Cymoxanil
Cypermethrin
Cyphenothrin
Cyprazine
Cyproconazole
Cyprodinil
Cyprofuram
Cyromazine
Cythioate
Dazomet
DCPA
DDT
DEET
DEF
Deltamethrin
Demephion
Demeton
Desmedipham
Desmetryn
Diafenthiuron
Dialifor
Diallate
Diamidafos
Diazinon
Dicamba[1]
Dicapthon
Dichlobenil
Dichlofenthion
Dichlofluanid
Dichlormid
Dichlorophen
Dichlorprop[1]
Dichlorvos
Diclobutrazol
Diclocymet
Diclofop[1]
Diclofop-methyl
Diclomezine
Dicloran
Dicofol
Dicrotophos
Dicryl
Dicyclanil
Dieldrin
Diethatyl-ethyl
Diethofencarb
Difenoconazole
Difenoxuron
Diflovidazin
Diflubenzuron
Diflufenican
Diflufenzopyr[1]
Diflumetorim
Dimefluthrin
Dimefox
Dimepiperate
Dimethachlone
Dimethachlor
Dimethametryn
Dimethenamid
Dimethipin
Dimethirimol
Dimethoate
Dimethomorph
Dimetilan
Dimoxystrobin
Diniconazole
Dinitramine
Dinobuton
Dinocap
Dinoseb
Dinoseb acetate
Dinotefuran
Dinoterb acetate
Diofenolan
Diothyl
Dioxacarb
Dioxathion
Diphenamid
Diphenylamine
Dipropetryn
Disulfoton
Ditalimfos
Dithianon
Dithiopyr
Diuron
Dodemorph
Dodine
Drazoxolon
Edifenphos
Emamectin benzoate
Empenthrin
Endosulfan
Endrin
EPN
Epoxiconazole
EPTC
Esfenvalerate
Esprocarb
Etaconazole
Ethaboxam
Ethalfluralin
Ethiofencarb
Ethiolate
Ethion
Ethiprole
Ethirimol
Ethofumesate
Ethoprop
Ethoxyquin
Ethychlozate
Etobenzanid
Etofenprox
Etoxazole
Etridiazole
Etrimfos
Famoxadone
Famphur
Fenamidone
Fenamiphos
Fenarimol
Fenazaflor
Fenazaquin
Fenbuconazole
Fenbutatin oxide
Fenclorim
Fenfuram
Fenhexamid
Fenitrothion
Fenobucarb (BPMC)
Fenothiocarb
Fenoxanil
Fenoxaprop-ethyl
Fenoxycarb
Fenpiclonil
Fenpropathrin
Fenpropidin
Fenpropimorph
Fenpyrazamine
Fenpyroximate, e-
Fenson
Fensulfothion
Fenthion
Fenuron
Fenvalerate
Ferimzone
Fipronil
Flamprop-isopropyl
Flamprop-methyl
Flonicamid
Fluacrypyrim

Fluazifop butyl ester
Fluazifop-p-butyl
Fluazolate
Fluazuron
Flubendiamide
Flubenzimine
Fluchloralin
Flucycloxuron
Flucythrinate
Fludioxonil
Fluensulfone
Flufenacet
Flufenoxuron
Flufenpyr ethyl
Flufiprole
Flumetralin
Flumetsulam
Flumiclorac-pentyl
Flumioxazin
Flumorph
Fluometuron
Fluopicolide
Fluopyram
Fluoranthene
Fluorene
Fluorochloridone
Fluorodifen
Fluoroimide
Fluotrimazole
Fluoxastrobin
Flupyradifurone
Fluquinconazole
Fluridone
Fluroxypyr[1]
Flurprimidol
Flurtamone
Flusilazole
Fluthiacet-methyl
Flutolanil
Flutriafol
Fluvalinate
Fluxapyroxad
Folpet
Fomesafen
Fonofos
Forchlorfenuron
Formetanate
Formothion
Fosthiazate
Fosthietan
Fuberidazole
Furalaxyl
Furametpyr
Furathiocarb
Furilazole
Furmecyclox
Gardona
Glufosinate[2]
Glyphosate[2]
Halauxifen-methyl
Halfenprox
Halofenozide
Haloxyfop[1]
Haloxyfop-methyl
Heptachlor
Heptenophos
Hexachlorobutadiene
Hexachlorophene
Hexaconazole
Hexaflumuron
Hexazinone
Hexythiazox
Hydramethylnon
Hydroprene
IBP
Imazalil
Imazamethabenz[1]
Imazamethabenz methyl ester
Imazamox[1]
Imazapic[1]
Imazapyr[1]
Imazaquin[1]
Imazethapyr[1]
Imibenconazole
Imidacloprid
Imiprothrin
Indanofan
Indaziflam
Indoxacarb
Ioxynil
Ipconazole
Ipfencarbazone
Iprodione
Iprovalicarb
Isazofos
Isobenzan
Isocarbamid
Isocarbophos
Isodrin
Isofenphos
Isofetamid
Isomethiozin
Isoprocarb
Isopropalin
Isoprothiolane
Isoproturon
Isopyrazam
Isotianil
Isoxadifen-ethyl
Isoxaflutole
Isoxathion
Ivermectin
Jodfenphos
Karbutilate
Kinoprene
Kresoxim-methyl
Lactofen
Lambda-cyhalothrin
Lenacil
Leptophos
Lindane
Linuron
Lufenuron
Malathion
Mandestrobin
Mandipropamid
MCPA[1]
MCPA methyl ester
MCPB[1]
Mecarbam
Mecoprop[1]
Mefenacet
Mefenpyr-diethyl
Mefluidide
Mepanipyrim
Meperfluthrin
Mephosfolan
Mepronil
Meptyldinocap
Metaflumizone
Metalaxyl
Metaldehyde
Metamifop
Metamitron
Metazachlor
Metconazole
Methabenzthiazuron (MBTZ)
Methacrifos
Methamidophos
Methfuroxam
Methidathion
Methiocarb
Methomyl
Methoprene
Methoprotryne
Methoxychlor
Methoxyfenozide
Metobromuron
Metofluthrin

Metolachlor
Metolcarb
Metominostrobin
Metoxuron
Metrafenone
Metribuzin
Metsulfuron methyl
Mevinphos
Mexacarbate
MGK 264
MGK-326
Mirex
Molinate
Momfluorothrin
Monalide
Monocrotophos
Moxidectin
MPPA[2]
Myclobutanil
N-acetylglufosinate[2]
Naled
Naphthalene
Naphthaleneacetamide
Naproanilide
Napropamide
Naptalam
Nicotine
Nitenpyram
Nitralin
Nitrapyrin
Nitrofen
Nitrothal-isopropyl
Norea
Norflurazon
Novaluron
Noviflumuron
Nuarimol
Octhilinone
Ofurace
Orbencarb
Orysastrobin
Oryzalin
Oxadiazon
Oxadixy[1]
Oxamyl
Oxathiapiprolin
Oxpoconazole
Oxydemeton-methyl
Oxydeprofos
Oxyfluorfen
Oxythioquinox
Paclobutrazol
Parathion
Parathion methyl
PCBs
Pebulate
Penconazole
Pencycuron
Pendimethalin
Penflufen
Pentachlorophenol[1]
Pentanochlor
Penthiopyrad
Pentoxazone
Permethrin
Perthane
Pethoxamid
Phenkapton
Phenmedipham
Phenothiazine
Phenothrin
Phenthoate
Phenylphenol, o-
Phorate
Phosalone
Phosfolan
Phosmet
Phosphamidon
Phoxim
Phthalide
Picloram[1]
Picolinafen
Picoxystrobin
Pindone
Pinoxaden
Piperalin
Piperonyl butoxide
Piperophos
Pirimicarb
Pirimiphos ethyl
Pirimiphos methyl
Plifenate
Prallethrin
Pretilachlor
Probenazole
Prochloraz
Procymidone
Prodiamine
Profenofos
Profluralin
Profoxydim
Prohydrojasmon
Promecarb
Prometon
Prometryn
Pronamide
Propachlor
Propamocarb
Propanil
Propaphos
Propaquizafop
Propargite
Propazine
Propetamphos
Propham
Propiconazole
Propisochlor
Propoxur
Propoxycarbazone
Proquinazid
Prosulfocarb
Prothioconazole
Prothiofos
Prothoate
Prynachlor
Pydiflumetofen
Pymetrozine
Pyracarbolid
Pyraclofos
Pyraclostrobin
Pyraflufen ethyl
Pyrazophos
Pyrazoxyfen
Pyrene
Pyrethrins
Pyribencarb
Pyributicarb
Pyridaben
Pyridalyl
Pyridaphenthion
Pyridate
Pyridinitril
Pyrifenox
Pyrifluquinazon
Pyriftalid
Pyrimethanil
Pyrimidifen
Pyriminobac-methyl
Pyriofenone
Pyriproxyfen
Pyroquilon
Pyroxasulfone
Quinalphos
Quinclorac[1]
Quinoclamine
Quinoxyfen
Quintozene
Quizalofop[1]
Quizalofop ethyl ester

Rabenzazole
Resmethrin
Ronnel
Rotenone
Saflufenacil
Salithion
Schradan
Sebuthylazine
Secbumeton
Sedaxane
Sethoxydim
Silafluofen
Silthiofam
Simazine
Simeconazole
Simetryne
Spinetoram
Spinosad
Spirodiclofen
Spiromesifen
Spirotetramat
Spiroxamine
Sulfentrazone
Sulfluramid
Sulfotepp
Sulfoxaflor
Sulprofos
Swep
TCMTB
Tebuconazole
Tebufenozide
Tebufenpyrad
Tebupirimfos
Tebutam
Tebuthiuron
Tecnazene
Teflubenzuron
Tefluthrin
Temephos
TEPP
Tepraloxydim
Terbacil
Terbufos
Terbumeton
Terbuthylazine
Terbutryn
Tetraconazole
Tetradifon
Tetramethrin
Tetrasul
Thenylchor
Thiabendazole
Thiacloprid
Thiamethoxam
Thiazopyr
Thidiazuron
Thifluzamide
Thiobencarb
Thiocyclam
Thiodicarb
Thiofanox
Thiometon
Thionazin
Thiophanate-methyl
Thioquinox
Tiadinil
Tioxazafen
Tolclofos methyl
Tolfenpyrad
Tolpyralate
Tolyfluanid
Tralkoxydim
Transfluthrin
Triadimefon
Triadimenol
Tri-allate
Triamiphos
Triapenthenol
Triazamate
Triazophos
Triazoxide
Tributoxy PO_4
Trichlamide
Trichlorfon
Trichloronat
Triclopyr
Triclosan
Tricyclazole
Tridemorph
Tridiphane
Trietazine
Trifenmorph
Trifloxystrobin
Triflumizole
Triflumuron
Trifluralin
Triforine
Trimethacarb
Triphenyl PO_4
Tris(1,3-dichloro-2-propyl) PO_4
Tris(beta-chloroethyl) PO_4
Tris(chloropropyl) PO_4
Triticonazole
Tycor
Uniconazole
Valifenalate
Vamidothion
Vernolate
Vinclozolin
Zoxamide

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[1] Acid herbicide included within the scope of the acid herbicides SRM.
[2] Glyphosate, glufosinate, and their degradants MPPA (3-(hydroxymethylphosphinyl) propanoic acid) and N-acetylglufosinate are within the scope of the glyphosate SRM.
[3] 3,4-Dichloroaniline is a metabolite of multiple pesticides.
[4] BAM is a degradant of both fluopicolide and dichlobenil.
[5] Carbendazim is both a fungicide and a degradant of thiophanate methyl; it was reported under the category of thiophanate methyl in the 2015 and 2016 pesticide residue monitoring reports.

Appendix B. Analysis of Domestic Human Foods by Commodity Group in FY 2021

Commodity Group	Samples Analyzed (N)	Without Residues N (%)†	Violative Samples* N (%)†	Over Tolerance Violations (N)	No Tolerance Violations (N)
All Domestic Samples – Totals	**300**	**105 (35.0)**	**10 (3.3)**	**2**	**10**
Grains/Grain Products – Totals	**11**	**4 (36.4)**	**0**	**0**	**0**
Corn and corn products	4	3 (75.0)	0	0	0
Rice and rice products	4	0	0	0	0
Soybeans and soybean products	2	1 (50.0)	0	0	0
Wheat and wheat products	1	0	0	0	0
Fish/Shellfish/Other Aquatic Products - Totals	**11**	**11 (100)**	**0**	**0**	**0**
Aquaculture seafood	10	10 (100)	0	0	0
Fish and fish products	1	1 (100)	0	0	0
Fruits - Totals	**105**	**18 (17.1)**	**0**	**0**	**0**
Apple fruit/juice	8	0	0	0	0
Apricot fruit/juice	4	0	0	0	0
Avocadoes	9	6 (66.7)	0	0	0
Blackberry fruit/juice	1	0	0	0	0
Blueberry fruit/juice	3	1 (33.3)	0	0	0
Cantaloupe	3	2 (66.7)	0	0	0
Cherry fruit/juice	4	1 (25.0)	0	0	0
Grapefruit fruit/juice	10	0	0	0	0
Grapefruit/juice, raisins	9	0	0	0	0
Lemon fruit/juice	7	0	0	0	0
Nectarine fruit/juice	6	0	0	0	0
Orange fruit/juice	4	0	0	0	0
Papaya fruit/juice	5	0	0	0	0
Peach fruit/juice	5	0	0	0	0
Pear fruit/juice	4	0	0	0	0
Pineapple fruit/juice	5	0	0	0	0
Raspberry fruit/juice	5	0	0	0	0
Strawberry fruit/juice	5	1 (20.0)	0	0	0
Other citrus fruit/juice	1	1 (100)	0	0	0
Other fruits/juices	7	6 (85.7)	0	0	0

Commodity Group	Samples Analyzed (N)	Without Residues N (%)†	Violative Samples* N (%)†	Over Tolerance Violations (N)	No Tolerance Violations (N)
Vegetables – Totals	**153**	**63 (41.2)**	**10 (6.5)**	**2**	**10**
Asparagus	4	3 (75.0)	0	0	0
Artichoke	8	2 (25.0)	0	0	0
Bok choy	5	1 (20.0)	1 (20.0)	0	1
Broccoli	5	2 (40.0)	0	0	0
Cabbage	6	2 (33.3)	1 (16.7)	0	1
Carrots	6	2 (33.3)	0	0	0
Cauliflower	9	4 (44.4)	0	0	0
Celery	2	0	0	0	0
Cilantro	2	0	1 (50.0)	0	1
Collards	1	1 (100)	0	0	0
Corn	8	7 (87.5)	0	0	0
Cucumbers	10	3 (30.0)	0	0	0
Kale	1	1 (100)	0	0	0
Lettuce, leaf	5	1 (20.0)	0	0	0
Mushrooms/truffles/fungi	6	3 (50.0)	0	0	0
Okra	6	5 (83.3)	0	0	0
Onions/leeks/scallions/shallots	7	4 (57.1)	1 (14.3)	0	1
Peas (green/snow/sugar/sweet)	1	0	0	0	0
Peppers, hot	5	1 (20.0)	0	0	0
Peppers, sweet	4	3 (75.0)	0	0	0
Potatoes	4	3 (75.0)	0	0	0
Red beets	4	0	4 (100)	1	4
Spinach	6	0	1 (16.7)	1	1
Squash	2	1 (50.0)	0	0	0
String beans (green/snap/pole/long)	5	2 (40.0)	0	0	0
Sweet potatoes	4	1 (25.0)	0	0	0
Tomatoes	7	3 (42.9)	0	0	0
Other bean and pea products	14	2 (14.3)	1 (7.1)	0	1
Other root and tuber vegetables	6	6 (100)	0	0	0

Commodity Group	Samples Analyzed (N)	Without Residues N (%)†	Violative Samples* N (%)†	Over Tolerance Violations (N)	No Tolerance Violations (N)
Other Food Products - Totals	**20**	**9 (45.0)**	**0**	**0**	**0**
Peanuts and peanut products	1	1 (100)	0	0	0
Almonds	6	1 (16.7)	0	0	0
Pecans	5	4 (80.0)	0	0	0
Pistachios	5	0	0	0	0
Refined oil	1	1 (100)	0	0	0
Animal products/byproducts	2	2 (100)	0	0	0

†Percentage of the number of samples analyzed per commodity group
*Total number of violative samples may not equal sum of samples with over-tolerance and no-tolerance violations because one sample can contain pesticide chemical residues of both violation types.

Appendix C. Analysis of Import Human Foods by Commodity Group in FY 2021

Commodity Group	Samples Analyzed (N)	Without Residues N (%)†	Violative Samples* N (%)†	Over Tolerance Violations (N)	No Tolerance Violations (N)
All Import Samples - Totals	**1067**	**475 (44.5)**	**114 (10.7)**	**27**	**100**
Grains/Grain Products - Totals	**67**	**36 (53.7)**	**6 (9.0)**	**0**	**6**
Barley and barley products	3	1 (33.3)	0	0	0
Corn and corn products	3	1 (33.3)	0	0	0
Macaroni and noodles	5	4 (80.0)	0	0	0
Rice and rice products	31	15 (48.4)	4 (12.9)	0	4
Wheat and wheat products	12	6 (50.0)	2 (16.7)	0	2
Other grains and grain products	13	9 (69.2)	0	0	0
Milk/Dairy Products/Eggs - Totals	**1**	**1 (100)**	**0**	**0**	**0**
Milk, cream and cheese products	1	1 (100)	0	0	0
Aquaculture seafood	16	15 (93.8)	0	0	0
Fish/Shellfish/Other Aquatic Products - Totals	**19**	**17 (89.5)**	**0**	**0**	**0**
Fish and fish products	2	1 (50.0)	0	0	0
Shellfish and crustaceans	1	1 (100)	0	0	0
Fruits - Totals	**253**	**100 (39.5)**	**26 (10.3)**	**4**	**25**
Apple fruit/juice	10	3 (30.0)	0	0	0
Apricot fruit/juice	7	4 (57.1)	0	0	0
Avocado fruit/juice	7	6 (85.7)	0	0	0
Bananas, plantains	1	1 (100)	0	0	0
Blackberry fruit/juice	4	1 (25.0)	0	0	0
Blueberry fruit/juice	13	7 (53.8)	1 (7.7)	0	1
Cantaloupe	3	1 (33.3)	1 (33.3)	0	1
Cherry fruit/juice	8	2 (25.0)	1 (12.5)	0	1
Clementine fruit/juice	2	0	0	0	0
Cranberry fruit/juice	5	3 (60.0)	0	0	0
Currant fruit/juice	1	0	0	0	0
Date fruit/juice	14	13 (92.9)	0	0	0
Dragon fruit/juice	1	1 (100)	0	0	0
Fig fruit/juice	6	1 (16.7)	5 (83.3)	0	5
Grapefruit fruit/juice	2	0	0	0	0

Commodity Group	Samples Analyzed (N)	Without Residues N (%)†	Violative Samples* N (%)†	Over Tolerance Violations (N)	No Tolerance Violations (N)
Fruits – Totals (Cont'd)	**253**	**100 (39.5)**	**26 (10.3)**	**4**	**25**
Grapefruit/juice, raisins	30	7 (23.3)	3 (10.0)	1	3
Guava fruit/juice	1	0	1 (100)	0	1
Honeydew melon	6	2 (33.3)	1 (16.7)	1	0
Lemon fruit/juice	2	1 (50.0)	0	0	0
Lime fruit/juice	23	6 (26.1)	0	0	0
Mango fruit/juice	14	8 (57.1)	0	0	0
Olives	8	3 (37.5)	4 (50.0)	1	4
Orange fruit/juice	4	1 (25.0)	0	0	0
Papaya fruit/juice	22	3 (13.6)	1 (4.5)	0	1
Peach fruit/juice	2	0	0	0	0
Pear fruit/juice	2	1 (50.0)	0	0	0
Pineapple fruit/juice	5	0	1 (20.0)	0	1
Plum fruit/juice, prunes	3	1 (33.3)	0	0	0
Prickly pear fruit/juice	7	3 (42.9)	3 (42.9)	0	3
Raspberry fruit/juice	9	4 (44.4)	0	0	0
Strawberry fruit/juice	14	5 (35.7)	2 (14.3)	0	2
Other berry fruit/juice	2	2 (100)	0	0	0
Other citrus fruit/juice	1	0	0	0	0
Other melons/vine fruit/juice	1	0	1 (100)	0	1
Other sub-tropical fruit/juice	7	5 (71.4)	1 (14.3)	1	1
Other fruits/juices	6	5 (83.3)	0	0	0
Vegetables - Totals	**626**	**248 (39.6)**	**74 (11.8)**	**23**	**61**
Asparagus	8	7 (87.5)	0	0	0
Bok choy and Chinese cabbage	5	0	0	0	0
Broccoli	11	6 (54.5)	1 (9.1)	0	1
Brussels sprouts	3	0	0	0	0
Cabbage	8	4 (50.0)	1 (12.5)	0	1
Carrots	24	11 (45.8)	4 (16.7)	1	3
Cauliflower	9	7 (77.8)	0	0	0
Celery	5	1 (20.0)	1 (20.0)	0	1
Choyote, chayote	1	1 (100)	0	0	0
Cilantro	37	2 (5.4)	14 (37.8)	5	13
Collards	2	0	0	0	0
Corn	17	17 (100)	0	0	0
Cucumbers	31	3 (9.7)	1 (3.2)	1	0

Commodity Group	Samples Analyzed (N)	Without Residues N (%)†	Violative Samples* N (%)†	Over Tolerance Violations (N)	No Tolerance Violations (N)
Vegetables – Totals (Cont'd)	**626**	**248 (39.6)**	**74 (11.8)**	**23**	**61**
Eggplant	19	5 (26.3)	1 (5.3)	1	0
Endive	2	2 (100)	0	0	0
Garbanzo beans	11	9 (81.8)	0	0	0
Garlic	13	12 (92.3)	0	0	0
Ginger	35	14 (40.0)	1 (2.9)	1	0
Kale	2	0	1 (50.0)	0	1
Kidney beans	5	5 (100)	0	0	0
Lettuce, head	6	4 (66.7)	0	0	0
Lettuce, leaf	3	0	1 (33.3)	0	1
Mung beans	12	4 (33.3)	0	0	0
Mushrooms/truffles/fungi	22	18 (81.8)	3 (13.6)	1	2
Okra	5	2 (40.0)	0	0	0
Onions/leeks/scallions/shallots	46	16 (34.8)	12 (26.1)	3	9
Peas (green/snow/sugar/sweet)	9	6 (66.7)	1 (11.1)	1	0
Peppers, hot	66	12 (18.2)	11 (16.7)	4	8
Peppers, sweet	28	7 (25.0)	2 (7.1)	0	2
Potatoes	13	3 (23.1)	0	0	0
Pumpkins	1	1 (100)	0	0	0
Radishes	18	7 (38.9)	3 (16.7)	3	3
Red beets	15	10 (66.7)	2 (13.3)	0	2
Spinach	7	3 (42.9)	2 (28.6)	0	2
Squash	20	2 (10.0)	2 (10.0)	1	2
String beans (green/snap/pole/long)	26	7 (26.9)	3 (11.5)	1	3
Sweet potatoes	2	1 (50.0)	0	0	0
Taro/dasheen	2	2 (100)	0	0	0
Tomatoes/tomatillos	30	16 (53.3)	0	0	0
Vegetables, other, or mixed	9	6 (66.7)	0	0	0
Other bean/pea vegetables/products	24	10 (41.7)	3 (12.5)	0	3
Other cucurbit vegetables	3	2 (66.7)	0	0	0
Other leaf and stem vegetables	9	2 (22.2)	4 (44.4)	0	4
Other root and tuber vegetables	2	1 (50.0)	0	0	0

Commodity Group	Samples Analyzed (N)	Without Residues N (%)†	Violative Samples* N (%)†	Over Tolerance Violations (N)	No Tolerance Violations (N)
Other Food Products - Totals	**101**	**73 (72.3)**	**8 (7.9)**	**0**	**8**
Candy, confections, chocolate, cocoa products	2	1 (50.0)	1 (50.0)	0	1
Coconut and coconut products	1	0	0	0	0
Dietary supplement, botanical/herbal	1	1 (100)	0	0	0
Honey and honey products	6	6 (100)	0	0	0
Multi-ingredient foods (dinners, sauces, etc.)	1	1 (100)	0	0	0
Nuts, almonds	12	12 (100)	0	0	0
Nuts, cashews	5	4 (80.0)	0	0	0
Nuts, peanuts and peanut products	4	0	1 (25.0)	0	1
Nuts, pecans	2	1 (50.0)	0	0	0
Nuts, pistachios	4	2 (50.0)	0	0	0
Nuts, other	9	8 (88.9)	0	0	0
Oil, olive	12	8 (66.7)	2 (16.7)	0	2
Oil, vegetable	2	1 (50.0)	1 (50.0)	0	1
Seeds, edible and seed products	36	25 (69.4)	3 (8.3)	0	3
Spices	3	2 (66.7)	0	0	0
Other food products	1	1 (100)	0	0	0

†Percentage of the number of samples analyzed per commodity group.
*Total number of violative samples may not equal sum of samples with over-tolerance and no-tolerance violations because one sample can contain pesticide chemical residues of both violation types.