Report on the Environment
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Pesticide Residues in Food

Pesticides are substances or mixtures of substances intended for preventing, destroying, repelling, or mitigating plant or animal pests and may include herbicides, insecticides, fungicides, and rodenticides. More than a billion pounds of pesticides are used in the U.S. each year to control weeds, insects, and other organisms that threaten or undermine human activities (U.S. EPA, 2017). Some of these compounds can be harmful to human health if sufficient quantities are ingested, inhaled, or otherwise contacted (see the Urinary Pesticides indicator). Potential health effects and primary exposure routes vary by chemical. The most common routes of exposure for the general population are ingestion of a treated food source and contact with applications in or near residential sites. Pesticides may also be harmful in the environment when non-target organisms are exposed.

This indicator represents data from the U.S. Department of Agriculture's Pesticide Data Program (PDP), which measures residue levels for hundreds of pesticides and their metabolites in fruits, vegetables, grains, meat, and dairy products from across the country, sampling different combinations of commodities each year. PDP has also continued testing for some persistent and bioaccumulative pesticides that have been banned since the 1970s, such as aldrin/dieldrin, heptachlors, and DDT and its metabolites. PDP data collection began in 1991 and includes both domestic and foreign-produced commodities. Results are published in annual reports, which include statistics on the number of pesticide residues detected, the number of residues exceeding the tolerance established by EPA for a given pesticide-commodity pair (Code of Federal Regulations, Title 40, Part 180), and the number of residues detected for which no tolerance has been established. This indicator depicts data from 1994 to 2019; data from before 1994 are considered less reliable. Between 1994 and 2019, the number of food samples analyzed per year ranged from a low of 5,771 (1996) to a high of 13,693 (2005), and it has decreased slightly since 2005, to a total of 9,697 in 2019.

What the Data Show

The percentage of samples with no detectable pesticide residues generally increased during the period from 1994 to 2002 (Exhibit 1). Samples with no detects accounted for 38.5 percent of samples analyzed in 1994 and rose to 57.9 percent of samples in 2002. From 2003 to 2019, the percentage of samples with no detectable pesticides or residues fluctuated between a high of 53.9 percent of samples (in 2003) and a low of 15.5 percent (in 2015). Data for 2019 showed 42.5 percent of samples had no detects. The largest increase in detects compared to 2018 was in those samples with detection of four or more residues. The average percentage of samples with detections of four or more residues over the 17-year period from 2003 to 2019 is 16.2 percent, with a maximum of 44.3 percent in 2015. In 2019, 20.2 percent of samples contained four or more residues, above the average from 2003 to 2019 average. Compared with previous years, PDP sampled primarily fresh fruits and vegetables in 2015 and excluded most processed commodities, grains, and other miscellaneous commodities; this was a major reason for the 2015 increase in samples containing four or more pesticides. Fresh and processed fruit and vegetables still accounted for 87.0 percent of all samples collected in 2019.

Exhibit 2 illustrates the percentage of samples in which at least one pesticide residue was detected at a concentration exceeding the tolerance established by EPA for a given pesticide-commodity pair. The percentage of samples exceeding EPA tolerance values was 0.05 percent in 1994, and it peaked at 1.29 percent in 2019, the most recent year for which data are available. For 2019, residues exceeding the tolerance were detected in 125 samples (1.29 percent) of the total samples tested (9,697 samples). The samples containing pesticides that exceeded established tolerances included: 93 samples of basil (of 343 samples), 1 sample of cilantro (of 176 samples), 3 samples of collard greens (of 187 samples), 3 samples of dried garbanzo beans (of 686 samples), 2 samples of hot peppers (of 651 samples), 8 samples of mustard greens (out of 595 samples), 2 samples of radishes (of 712 samples), 5 samples of frozen spinach (of 189 samples), and 8 samples of frozen strawberries (of 564 samples).

Limitations

- As stated in the Exhibit 1 footnotes, PDP data showing the percentage of samples with a given number of pesticides detected from 2002 and earlier cannot be compared directly with data gathered after 2002. (Before 2003, each compound detected was counted separately; beginning in 2003, measurement of a parent compound and/or any of its metabolites was counted as a single detect.) Additionally, PDP has refined its analytical methods in order to measure a greater number of pesticide analytes (both parent compounds and metabolites) and lowered its analytical limits of detection. Therefore, some increases in the percentage of detects may reflect improvements in PDP's analytical method capabilities.
- PDP does not sample all commodities in each individual survey year, which introduces uncertainty in evaluating changes in the percentage of detects and percentage of samples exceeding tolerances. Therefore, differences in the percentage of detections for any given pesticide class might not be due to an increase or decrease in the predominance of detectable residues; these differences might simply reflect the changing nature and identity of the commodities selected for inclusion in any given timeframe.
- The indicator provides summary information on pesticide residues on food, but it does not evaluate exposure from dietary intake or assess risks to human health and the environment.

Data Sources

Data for this indicator were obtained from a series of annual summary reports published by the PDP (USDA AMS, 1996–2020). These reports are all available from https://www.ams.usda.gov/datasets/pdp/pdpdata. The Food and Drug Administration also collects data (not reported here) on pesticide residues in cooked food that may be a source of chemicals in human diets. These data are available at https://www.fda.gov/Food/FoodScienceResearch/TotalDietStudy/default.htm.

References

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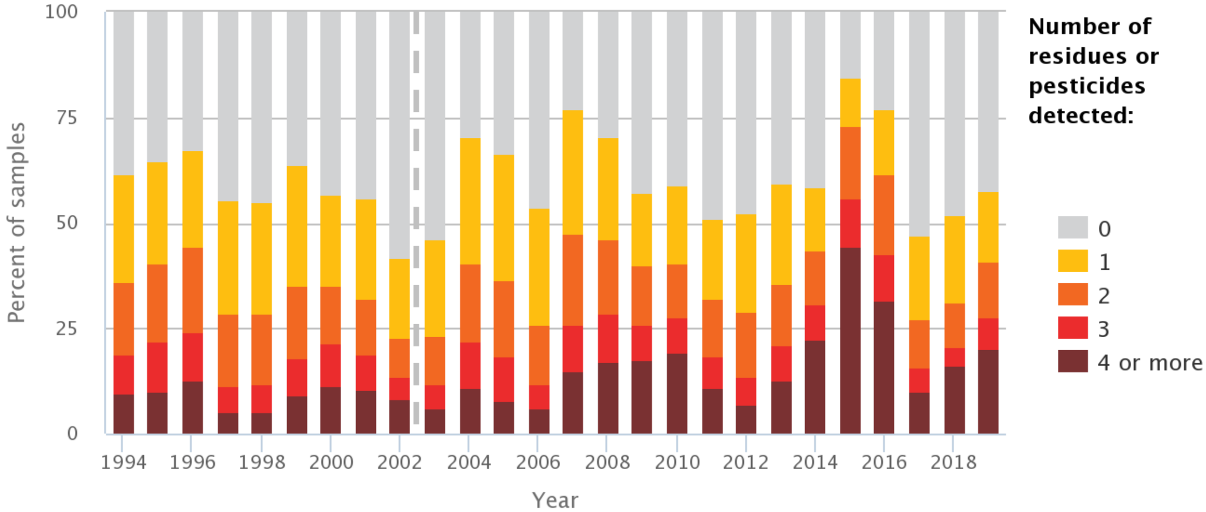
Exhibit 1. Pesticide detections in food in the U.S., 1994–2019



Coverage: Based on a survey of fruits, vegetables, grains, meat, and dairy products across the U.S., with different combinations of commodities sampled in different years. Each commodity group is tested for varying numbers of parent pesticides, metabolites, degradates, and/or isomers.

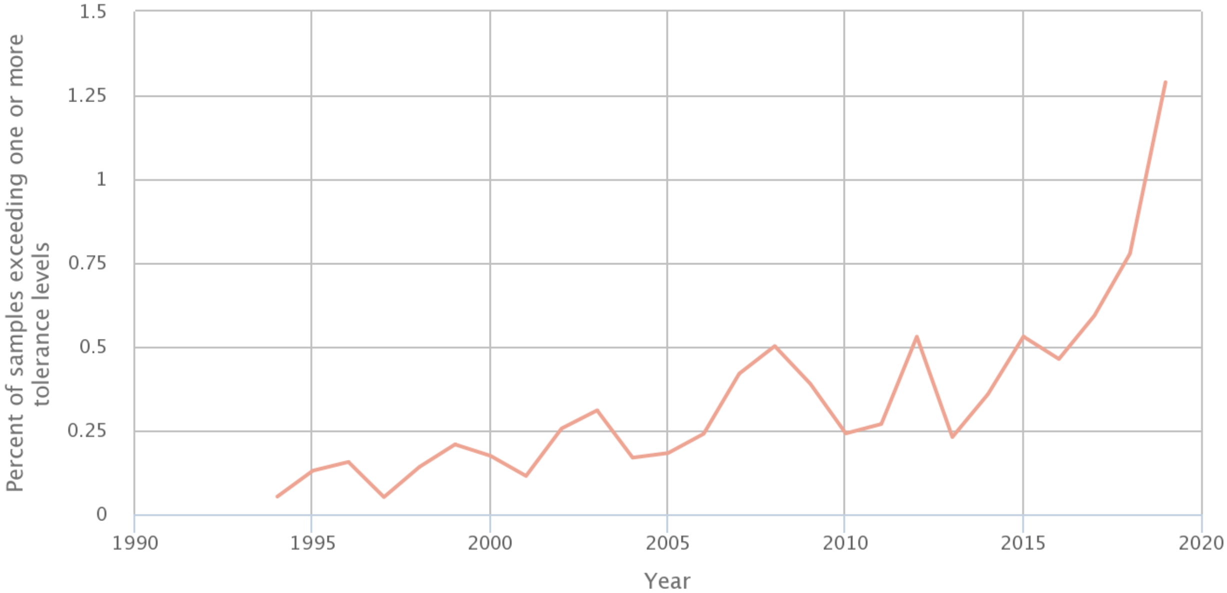
Data from 2003 to 2019 are not comparable to prior years due to a difference in how detects are counted. Beginning in 2003, parent compounds and their metabolites are combined to report the number of "pesticides" rather than the number of "residues," as reported prior to 2003. For example, a sample with positive detections for metabolites of a single pesticide – Endosulfan I, II, and sulfate, for example – would have been counted as three residues detected in the 2002 report. That same sample would be counted as just one pesticide detected in the 2003 report.

This indicator should be viewed only as summary information on pesticide residues in food. More refined chemical- and commodity-specific analyses would be required to draw conclusions about pesticide usage or dietary exposures and risks based on year-to-year comparisons or apparent trends. The indicator's high-level depiction of the U.S. Department of Agriculture's Pesticide Data Program data is confounded by the nature of sampling different commodities and different chemicals each year.

Information on the statistical significance of the trends in this exhibit is not presented here. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: USDA Agricultural Marketing Service, 1996–2020

Exhibit 2. Pesticides exceeding EPA tolerance levels in food in the U.S., 1994–2019



Coverage: Based on a random selection of fruits, vegetables, and other food across the U.S., with different combinations of commodities sampled in different years. The number of pesticides and their metabolites for which samples are analyzed varies depending on the commodities tested.

Information on the statistical significance of the trend in this exhibit is not presented here. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: USDA Agricultural Marketing Service, 1996–2020