Consumer Reports' 'Stop Eating Pesticides' Ratings Methodology, August 2020

We rated 35 fruits and vegetables on chronic dietary risk from pesticides, using an adjusted Dietary Risk Index to analyze test data from the USDA's Pesticide Data Program. Our analysis included results from 23,397 samples.

Data Collection

We used pesticide residue test results from the Department of Agriculture's Pesticide Data Program. The USDA's Agricultural Marketing Service (AMS) conducts the PDP each year to collect data on pesticide residues in food. The PDP tests a wide variety of foods for pesticide residues, with a focus on foods that are consumed by infants and children. The PDP chooses 12 to 15 types of foods to test every year, mostly fruits and vegetables.

We used the PDP data for fruits and vegetables tested in 2014, 2015, 2016, 2017, and 2018, for a total of 35 types of fruits and vegetables. We include both fresh and processed (frozen, canned, dried, and sauce) versions, when data was available, for a total of 49 items. If an item was tested in multiple years between 2014 and 2018, we used the data from the most recent test year. For a limited number of items, we used data from earlier test years. We used fresh plums from 2013 because dried plums were tested in 2018 and included in our analysis; we used organic orange data from 2015; and we used earlier test year data to bring the sample size to 10 or greater when necessary.

The PDP has developed extensive procedures that ensure that samples are randomly selected from the national food distribution system and that they reflect what is typically available to the American consumer. The PDP uses trained state inspectors who randomly collect samples at terminal markets and large chain store distribution centers throughout the country. Samples are collected from 10 states that account for about 50 percent of the U.S. population and represent all four census regions of the U.S. (West, South, Midwest, and Northeast), as well as the major agricultural production areas of the country. In 2018, over 560 sites granted access to sample collectors. The PDP states that it collects at least 600 samples per commodity per year (although this is not always the case), in order to provide an accurate statistical representation for a given commodity.

PDP state sample collectors are trained to adhere to detailed program standard operating procedures (SOPs) that provide criteria for site selection and specific instructions for sample selection, shipping and handling, and chain of custody.

Testing

The PDP tested samples at ISO-17025-accredited laboratories. ISO-17025 accreditation demonstrates that the laboratory meets a global standard for testing and calibration, ensuring that they operate a quality management system, are technically proficient, and are able to produce precise and accurate test and calibration data. Seven state laboratories and one USDA laboratory performed testing for PDP, using trained laboratory staff members.

The samples were tested for 465 to 518 parent pesticides, metabolites, degradates, and/or isomers, plus 22 or 23 environmental contaminants using multiresidue methods (MRMs). For analysis of fruits and vegetables, testing laboratories used various QuEChERS-based approaches. (QuEChERS stands for "quick, easy, cheap, effective, rugged, and safe.") All MRMs were determined, prior to use and through appropriate method validation procedures, to produce equivalent data for PDP analytical purposes.

PDP laboratories used gas chromatography (GC) and liquid chromatography (LC) instrumentation, coupled with tandem mass spectrometry (MS) detection systems for simultaneous identification/confirmation and quantitation of pesticides. The use of these GC-MS/MS and LC-MS/MS systems allowed the PDP to capture data for a broad spectrum of pesticides, including emerging product chemistries.

Before testing, each sample was prepared according to a uniform set of procedures, to ensure consistency and to reflect how a consumer would prepare a fruit or vegetable before eating it. For example, oranges and grapefruit were peeled, and any excess white membrane removed. Apples and kiwis were washed for 15 to 20 seconds and drained but not peeled. Potatoes and sweet potatoes were held under cold running tap water and gently scrubbed with a clean vegetable brush, then washed and drained.

The PDP releases a report annually with its analysis of the test results but also makes available to the public the raw data in Excel files, which are available for download at https://apps.ams.usda.gov/pdp. For our analysis, we used the raw data.

Analysis

Using the PDP's data, we calculated a Consumer Reports-adjusted aggregate Food System-Dietary Risk Index (CR FS-DRI) score for four categories within each of the 49 food items.[1] The four categories for each food item were domestic conventional, domestic organic, imported conventional, and imported organic (whenever data was available in each of these four categories). The aggregate FS-DRI score factors in the following:

- **The average amount of residue of each pesticide ("mean of the positives"):** We first calculated the mean level of each pesticide detected in each of the four categories of each food item, based on all positive samples (i.e., samples without detected residues are not

[1] https://hygeia-analytics.com/pesticides/dietary-risks/dietary-risk-index/

included in the calculation of the mean). If a particular food item contained residues of multiple pesticides, the mean of the positives was calculated separately for each pesticide.

- **The pesticide's chronic Reference Concentration (cRfC):** The cRfC is a measure of the pesticide's potential negative human health impacts. This number, calculated separately for each pesticide-food combination, is based on the Environmental Protection Agency's chronic reference dose for the specific pesticide, plus additional safety factors to protect human health and vulnerable populations (e.g., fetuses, infants, and children), which determines the chronic Population Adjusted Dose (cPAD). The Food Quality Protection Act of 1996 (FQPA) mandated that the EPA apply an additional tenfold safety factor to protect vulnerable populations, but the EPA has not done so for most pesticides. Therefore, we applied the tenfold safety factor in our cRfC calculation for pesticides that meet certain criteria. (See more details below.)

  The formula used to calculate the cRfC for a given food-pesticide combination is:

  $$\text{cRfC Pesticide}_x = (\text{Weight of person x cPAD for Pesticide}_x)/\text{Serving size of food}$$

  The cRfC represents a crude estimate of the maximum concentration of a pesticide that can be present in a daily serving of the particular food without exposing an individual to a dose of the pesticide that exceeds their personal limit. The cRfC depends on the weight of the individual, and our cRfC levels are based on the dietary risks to a child weighing 16 kilograms (35.2 pounds). The serving size of the food is a child's portion for each food item, calculated as approximately ⅔ of the Food and Drug Administration's Reference Amount Customarily Consumed.

  For each pesticide (Pesticide_x) detected in each of the four categories of a food item, a DRI of the Mean (DRI-M) is calculated, using the following formula:

  $$\text{DRI-M}_x = \text{Mean of the positives}_x/\text{cRfC}_x$$

- **The frequency of finding each pesticide:** For every pesticide detected at least once in each food item, we factored in the frequency of detecting the pesticide to calculate a Food System DRI (FS-DRI).

  The formula for the FS-DRI for each pesticide (Pesticide_x) is:

  $$\text{FS-DRI}_x = \text{DRI-M}_x \times \text{Frequency of detection}$$

- **The total number of different types of pesticides:** The final step in the calculation is to determine the aggregate FS-DRI for each food item by adding each pesticide's FS-DRI score.

Adjusting the DRI to Include the FQPA Safety Factor

In the calculation of each pesticide's chronic reference concentration (cRfC), we applied the Food Quality Protection Act's tenfold safety factor to the chronic Population Adjusted Dose (cPAD) for certain pesticides, to create more health-protective ratings. We applied the FQPA safety factor to any detected pesticide that is a neonicotinoid, a synthetic pyrethroid, an organophosphate, a carbamate, or a potential endocrine disruptor.

To determine which pesticides to include in the list of potential endocrine disruptors, we used two resources:

1. The Endocrine Disruption Exchange (TEDX) database. The Endocrine Disruption Exchange was a nonprofit research institute that produced and shared scientific evidence of endocrine disruption. TEDX researchers evaluated chemicals by searching the publicly available scientific literature and identifying peer-reviewed research showing effects on endocrine signaling. TEDX developed a master list of potential endocrine disruptors, defined as chemicals with at least one study demonstrating endocrine-disrupting properties.

2. The European Commission's 2016 report detailing the findings of its "EU Impact Assessment Report on Criteria to Identify Endocrine Disruptors." We assigned the FQPA safety factor to all pesticides listed in the report under its "Option 3," which includes the following:

    - Cat I: confirmed endocrine disruptor (ED). Adverse effects with a plausible link (i.e., same pathway) to mechanistic (endocrine mode of action) information or, in some specific cases, the pattern of adverse effects may be diagnostic of an ED mode of action.
    - Cat II: suspected ED. Specific adverse effects indicating endocrine disruption but without supporting mechanistic evidence, or *in vivo* mechanistic evidence without evidence for adverse effects.
    - Cat III: endocrine active. No *in vivo* evidence indicating endocrine adverse effects but mechanistic information *in vitro.*

Ratings

Using the final score (the aggregate CR-adjusted FS-DRI score), we placed each food item's domestic conventional, domestic organic, imported conventional, and imported organic version (whenever data was available) in one of five categories, which correspond to CR's five ratings. The DRI score ranges and meaning of the ranges are shown in the table below.

Rating	**CR-DRI score range**	**Number of servings that will lead a 35-pound child to reach or exceed their daily limit of "reasonable certainty of no harm" from chronic pesticide exposure**
Poor	2.00 or higher	⅛ to ½ daily serving
Fair	1.00 to 1.99	More than ½ serving to 1 serving daily
Good	0.33 to 0.99	More than 1 serving to 3 servings daily
Very Good	0.10 to 0.32	More than 3 servings to 10 servings daily
Excellent	Less than 0.09	More than 10 servings daily