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Understanding Pesticide Residues on Fruit and Vegetables: Fact vs. Fiction

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Every year, a publication of the twelve "dirtiest" produce items is released. This publication, called the "Dirty Dozen," claims to list produce items with a high amount of pesticide residue. This list makes headlines each year and worries consumers and farmers alike. Consumers worry that their favorite fruit or vegetable will wind up on the list and that eating that product might pose a risk to their health, while farmers worry that their key crops might get vilified as being "dirty."

First, what is a Pesticide?

Pesticides include any number of fungicides (which kill fungal diseases), insecticides (which kill insects) and herbicides (which kill weeds) that are used to combat pests to produce crops. Pesticides tend to have a negative image because they are used to kill things. Certain pesticides, if used improperly, can pose a health risk to humans, animals and other living organisms. Pesticides should always be used with caution. The entire label, especially the directions for application, should be read thoroughly before use and then followed exactly. Some pesticides are labeled as "restricted use," meaning special training and a pesticide applicator license is required. This is usually reserved for pesticides that require greater caution when applying.

All pesticides require federal approval before being released, sold and used by farmers.

The U.S. Environmental Protection Agency regulates pesticide use and has a rigorous process that requires the product to demonstrate very low risk to human health when used correctly. All pesticide products must go through a registration process requiring a review of data on the safety of the product, except those that are 25(b) exempt, which includes many pesticides used in organic agriculture[1]. This data is used to construct pesticide labels, which anyone who uses them must legally follow. The label is the law. Products will not make it through the stringent review process if they are found to be unsafe to human health.

Safety data the EPA collects includes[2]:

1. Evaluating if the product can cause harm to humans and under what circumstances (i.e. is it toxic to humans).
2. Evaluating the dose, or amount, that can cause harm.
3. Evaluating the exposure (timing and frequency) that may cause harm (e.g., how often a produce item is eaten).
4. Evaluating the overall risk, which involves combining all the information about the dose, exposure and conditions under which harm may occur. (Risk = Toxicity x Exposure.)

Based on all of this information, the EPA then sets tolerance levels regarding the acceptable amount of residue of a given pesticide on the produce item that will be consumed [3,4]. A given level has

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been determined to not cause harm to human health, based on likely exposure. This process is true for conventional pesticides. For some organically approved pesticides that are naturally derived, no tolerance levels are set[5].

Over time pesticides have become safer and we now use much lower application rates[6].

This is in part due to the Food Quality and Protection Act in 1996, which made pesticide labeling rules more strict, and ultimately banned many pesticides that were determined to be too dangerous. Additionally, there has been a shift from "broad spectrum" to "very specific" modes of action. A mode of action is the means by which a pesticide kills the target disease, insect or weed.

In the past, growers relied on pesticides that killed a broad range of organisms. Modern agriculture has shifted toward selective pesticides that target a more narrow range of organisms[7]. Newer pesticides are also applied at lower rates than many of their predecessors. No longer do we talk about application rates of gallons or pounds of pesticide per acre, but ounces or grams. For reference, an application rate of 1 ounce per acre amounts to about one shot glass of liquid over the area of a football field.

Are there Pesticides in Organic Produce?

It is important to realize that pesticides both naturally and synthetically derived are used in organic agriculture to produce organically certified food.

Just because agricultural products are organically certified does not mean that they are "pesticide free." Organic certification instead refers to a set of principles that govern how the food is grown. In the United States, these rules for organic certification are governed by the National Organic Program (NOP)[8].

Inspection of Produce for Pesticide Residues

The next step is ensuring that the food we eat does not contain levels of pesticide residue that exceed EPA limits. The U.S. Department of Agriculture regularly and randomly tests food at multiple locations across the country to check for pesticide residue and to make sure that produce is in compliance with the set tolerance levels[9]. Organic produce also goes through a similar process and is tested for pesticide residues to monitor for compliance with the NOP rules[10,11].

Pesticides: Amount, Type and why it Matters

It is important to remember that the USDA is looking for the amount and type of pesticide that is on the product when they do residue testing. This amount of residue of a given pesticide is key to determining if the produce is safe.

Why do we Care About the Amount of a Specific Pesticide?

The amount of the pesticide, or dose, is in large part what determines if a given pesticide will have any impact on its target or on human health.

To understand dosage, consider aspirin as an example. A small amount of aspirin might be good for you, but a large dose can be deadly. To establish pesticide tolerances, the EPA first determines the amount of pesticide necessary to cause harm to human health. Residue tolerance levels are generally set 100 to 1,000 times lower than the amount that produced no adverse effects during testing.

A yearly average of the USDA's testing of pesticide residues shows that nearly 99 percent of sampled products have residues below EPA tolerances[12, 13]. In 2019, 43 percent of produce sampled had no detectable residue. The remaining 55 percent had residue amounts below established tolerances[13,14]. Remember again that the pesticide tolerance level is already set well below the level at which any negative impact on human health is expected.

What about "The Dirty dozen"?

"The Dirty Dozen" is published each year by the Environmental Working Group. They use the data collected by the USDA's pesticide residue monitoring program[15] and use the average **number of pesticides and total amount of pesticide residue** (without regard to the pesticide type) found on a given food product to determine if it is "clean" or "dirty." They deem produce with a higher total amount of residue and with a greater number of pesticides residues as "dirty" and produce with residues from fewer types and smaller amounts as "clean."

The factors considered for this list do not tell us anything about how much risk any of the residues carry!

The most important factor that the EWG system does not consider is **risk**. When you only identify "dirty" food products using the number and total amount of pesticides and residue, you fail to identify what those

numbers actually mean. The EPA takes into account each pesticide and assigns limits based on their toxicity for this reason.

According to the EWG system, if *10 pesticides* are found at amounts 1,000 times lower than the tolerance limit set by EPA, that fruit could be ranked as "dirty." Meanwhile, another produce item that has only *one pesticide* residue at a slightly higher and potentially riskier amount of 100 times lower than the tolerance limit, that produce could be ranked as "clean." Food Scientists from UC Davis reviewed the actual pesticides and amounts present on EWG's dirty dozen list, along with their methodologies for creating the list[16]. These researchers concluded that pesticide residues on all 12 commodities posed negligible risk to consumers, and that organic produce options for these commodities did not represent a lower risk. The researchers also noted that EWG's ranking methods lacked scientific credibility.

Overall, the amount of pesticide residue on our food is very small and presents very low risk to our health based on the amount of fruits and vegetables we eat on a daily basis.

Calculate Pesticide Residue

Want to know how much of a given fruit you would have to eat in order to be at risk? There are pesticide residue calculators available that determine how much of a fruit or vegetable someone would need to eat in order to consume enough pesticide residue that would pose a risk to their health. The calculators take into account a person's age and known levels of pesticide residues on common fruits and vegetables and their associated risk levels. One of these calculators is referenced at the end of this fact sheet.

Example calculation:

Based on the highest residue recorded in strawberries an adult woman would need to eat 453 servings of strawberries in one day before she might be at risk due to any pesticide residue on the fruit.

This estimate is based on the highest pesticide residues recorded for strawberries and not on the pesticide residues found on average and therefore represents the highest possible risk level and not the average level of risk.

Take home message: "The Dirty Dozen" list isn't an accurate representation of the risk to our health from eating fruits and vegetables.

The risk of not eating fruits and vegetables is much more of a concern to our health than the likelihood of consuming trace amounts of pesticide residue. This is concerning since most of us already don't eat enough fruits and vegetables[17].

Our food supply is monitored and regulated. Both conventional and organic farmers do their best to ensure that the food they produce is safe. Growers are trained to comply with pesticide labels to ensure that pesticides are used safely in a way that does not put them or the consumer at risk. These pesticides are often necessary to efficiently grow produce and to ensure food availability. Growers generally apply the minimum amount required due to the high expense of pesticides.

One of the best ways to ensure you have access to high-quality and safe produce is to get to know your local farmers. There is a list of local farms in Arkansas available through the "Arkansas Grown" website, which is maintained by the Arkansas Department of Agriculture. By getting to know your local farmers, you can ask questions and learn about their practices. Good farmers are happy to have a conversation about how they grow the food that feeds our communities and their families. If you want organic produce, ask your local farmer for it! It is important to realize that growing food is difficult, and organic production requires more labor and more expensive inputs, which means it costs more to grow fruits and vegetables using organic practices. Being well-informed about the facts surrounding agriculture makes it easier to ask good questions and be a well-informed consumer.

References

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17. https://www.cdc.gov/media/releases/2017/p1116-fruit-vegetable-consumption.html

Links:

Pesticide Residue Calculator: https://www.safefruitsandveggies.com/pesticide-residue-calculator/

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