How Poisonous is DDT?

By Josh Bloom — February 11, 2016

With Zika being in the news constantly, and sounding a little worse every week, there have been murmurs about the possibility of using DDT to fight the infection, should it turn into a serious epidemic and become a public health threat. While there are some disturbing signs that Zika could, in fact, become a legitimate threat and not just another manufactured panic like many others, it is impossible to determine at this time what the magnitude of the problem will be.

Most "end-of-the-world" infections have turned out to be duds. We just don't know yet.

If it becomes a serious problem in America, it should provoke a serious scientific response, without political grandstanding. All options should be on the table. Yet all options probably won't be. Dichlorodiphenyltrichloroethane DDT may never be considered despite its considerable successes elsewhere, and for reasons that have little or nothing to do with science.

Perhaps no chemical evokes a stronger visceral response in Americans than DDT. Much of the public would consider it to be extremely poisonous. Some contend it is harmless. The toxicology is more nuanced, which is why it's rarely discussed. Without getting into the pros and cons of its ban, environmental consequences, or similar controversies, I thought it might be useful to examine the toxicity of the chemical based on real data.

Even if you can quote Rachel Carson's "Silent Spring" by heart, or you light a candle on the anniversary of its ban in the U.S., you may be surprised by what you don't know about DDT.

Animal toxicity Acute, single dose

DDT is considered to be "moderately toxic" by the EPA. If you are a savvy reader, you know that toxicity in itself is meaningless without understanding relative risk. It's why we give away ACSH coffee mugs with relative toxicity on them (See Note 1, below). The following table compares DDT's acute oral toxicity in several animal species to that of common substances. The measurement used to determine toxicity is LD\textsubscript{50} the dose required to kill half of the test animals. The higher the LD\textsubscript{50}, the less toxic a chemical is.
Since LD$_{50}$ values can vary considerably from one lab to another (thus the wide ranges) the exact numbers mean very little. However, you can easily see that in three species, DDT has approximately the same acute toxicity as aspirin, caffeine and Tylenol (acetaminophen). No one is in a panic about those.

So why so much fear about DDT? The answer lies in worries about...

**Bioaccumulation**

Polyhalogenated chemicals, such as DDT, and PCBs (there are 209 of them) are quite stable, chemically and metabolically. Most of them won’t even burn. Unlike the vast majority of drugs and other chemicals that you ingest, these compounds are not quickly metabolized and excreted. Rather, they accumulate, especially in fat. Though the presence of a chemical in the body does not mean that it is harmful, all things being equal it is usually preferable to have chemicals and drugs metabolized and excreted rather than be stored, especially if the chemical has appreciable toxicity.

For example, the half-life (the amount of time that it takes for a 50 percent reduction of the drug or chemical, usually in the blood) of aspirin is 20 minutes, but for DDT, it is about 10 years.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>LD$_{50}$ Rats</th>
<th>LD$_{50}$ Mice</th>
<th>LD$_{50}$ Dogs</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDT$^a$</td>
<td>113-800</td>
<td>150-300</td>
<td>500-750</td>
</tr>
<tr>
<td>Caffeine$^b$</td>
<td>140</td>
<td>127</td>
<td>140</td>
</tr>
<tr>
<td>Aspirin$^c$</td>
<td>200-1500</td>
<td>250-1100</td>
<td>700</td>
</tr>
<tr>
<td>Tylenol$^d$</td>
<td>2400$^d$</td>
<td>338$^d$</td>
<td>200$^e$</td>
</tr>
<tr>
<td>Codeine$^f$</td>
<td>427</td>
<td>250</td>
<td>69</td>
</tr>
</tbody>
</table>

LD$_{50}$ values are expressed as mg of chemical per kg body weight of animal.

References
(a) http://whs.rocklinusd.org/documents/Science/Lethal_Dose_Table.pdf
(b) caffeine/aspirin https://www.erowid.org/chemicals/caffeine/caffeine_data_sheet.shtml
(d) http://toxnet.nlm.nih.gov/cgi-bin/sis/search2/f/?./temp/*u6WpWH:3
(e)http://www.peteducation.com/article.cfm?c=2+1677&aid=2226
(f) http://toxnet.nlm.nih.gov/toxnet.nlm.nih.gov/cgi-bin/sis/search/a?dbs+hsdb:@term+@DOCNO+3043
So, there is little question that DDT, or one of its metabolites that could be found in virtually all of us in the 1970s should be present even now.

But does this make it harmful?

**Human toxicity**

There is no legitimate worry about human toxicity of DDT. Sixty percent of Americans weren't even alive in 1972 when DDT was banned, but people think it must have been banned because it was toxic. Not so. According to the CDC [2], "No effects have been reported in adults given small daily doses of DDT by capsule for 18 months (up to 35 milligrams [mg] every day)."

First things first: 35 mg is *not* a "small daily dose," at least when compared to what we usually think of when we think dose: drugs. Here are typical daily doses for a few common medicines:

- Valium - 10 mg
- Lipitor - 20 mg
- Prozac - 20 mg
- Prilosec - 20 mg
- Propranolol - 120 mg

Thirty-five mg is a *typical* daily dose for a drug, not a small one.

Also, "People exposed for a long time to small amounts of DDT (less than 20 mg per day), such as people who worked in factories where DDT was made, had some minor changes in the levels of liver enzymes in the blood."

*And* [3], "People who worked with DDT for a long time had some changes in the levels of liver enzymes, but these improved after exposure stopped."

There have been reports of serious, but non-lethal human poisoning from DDT, but these involved very large doses. For example, a father and son *mistook DDT for flour* [4], and became seriously ill, although they both recovered in two weeks.

The President of the United States convened experts to examine the issue, and the *Use of Pesticides* report disputed claims that DDT was a potential to human health or that alternatives would be just as effective. The only thing they noted was that regulations were deficient, so farmers who thought it worked well and was safe might be inclined to think more might work even better and over-spray it, with potential problems in the future that were not occurring at the time.

Residues can be detected in ecosystems, for the reasons I showed earlier, so there have been lingering concerns about ...

**Carcinogenicity**

If the evidence of human harm is weak (Note 2), then the evidence of carcinogenicity of DDT in humans is even weaker, according to the CDC [3]:

"Some studies in humans linked DDT levels in the body with breast cancer, but other studies have
not made this link. Other studies in humans have linked exposure to DDT/DDE [a DDT metabolite] with having lymphoma, leukemia, and pancreatic cancer. No definitive association with these cancers has been made."

Even more revealing is the lack of a dose-response: "Workers heavily exposed to DDT never had more cancer than workers not exposed to DDT."

The CDC is not in the business of protecting chemicals that have been banned for 45 years so there is no reason to think there is anything that the agency is missing.

What about the birds and the bees? For wildlife the case was less clear. Environmentalists began to blame the decline in populations of birds like the osprey and peregrine falcon on DDT, and there was no real way to prove them wrong until after it was banned. "Thin shells" due to DDT were considered cause and effect, but it later turned out not to be so. Data showed that in 1941, before DDT spraying, there were 197 bald eagles, but by 1960, at the height of DDT spraying, the number had increased to 891. The numbers were similar for falcons and other predatory birds.

When a scientist or group finds harm that others cannot, it is usually the case that they are on a fishing expedition. Today we call that p-hacking [5] or data dredging.

**Conclusion**

Although this is obviously not (and was never intended to be) a comprehensive report, based on toxicology and carcinogen data from multiple sources, it is safe to say that DDT's reputation as a deadly poison is not based on real evidence. In fact, it's the opposite.

The chemical is no more acutely toxic than drugs that we ingest every day. People who were fed a capsule containing a significant dose of the chemical for one-and-a-half years suffered no ill effects, and evidence for DDT causing cancer is so weak as to be in the realm of chance; scientifically nonexistent. It is, in fact, a rather ordinary chemical with a very bad reputation.

I have intentionally omitted ancillary factors, such as potential environmental impact, and insect resistance, in the interests of brevity and focus. Should the Zika outbreak become serious enough that public health officials need to consider using DDT, I wanted to make it clear that this is not a deadly poison that will kill you (our own EPA even created guidelines for other countries to spray it indoors, in cooperation with WHO). It is instead a rather benign chemical that you could eat and never know the difference.

**NOTES:**

(1)
(2) A 1969 study found a higher incidence of leukemia and liver tumors in mice fed DDT than in unexposed mice, but the World Health Organisation examined the data and found that all of the case and control mice those that did not receive the insecticide had alarmingly high cancer rates. This technique of using animals that are innately prone to cancer as models of carcinogenicity, notably Sprague Dawley rats, would also be mimicked by French activist Gilles-Eric Seralini in his war on the herbicide glyphosate.

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