Myth busting: Pesticide use in organic and conventional agriculture-Part II

This is the second of a three part series by Thomas DeGregori, PhD, University of Houston

Bacillus thuringiensis (called "*Bt*") that has been used for decades by organic farmers to control crop-eating insects and by the World Health Organization to kill mosquitoes without using more toxic chemical pesticides. It's also been engineered into some crops to naturally repel insects — which has sparked condemnation from anti-GMO activists.

The concern over the the use of Bt proteins is a subset of the obsession over GMOS. It is easier to scare people than educate them.

Ironically, in recent years, it has been conventionally bred varieties of crops such as celery, potatoes and zucchini that have been removed from the market because they were expressing large amounts of their naturally occurring toxins. Celery contains psoralens that increase sensitivity to sunlight that can lead to dermatitis or chloracne and being a mutagen, can lead to skin cancer. Celery also contains goitrogenic compounds that interfere with the uptake of iodine into the thyroid. Potatoes contain highly *toxic* compounds known as glycoalkaloids, of which the most prevalent are solanine and chaconine. *Zucchini* may occasionally contain a group of natural toxins known as cucurbitacins.

In 2002 in New Zealand, highly toxic zucchini led to sickness and hospitalization for those who ate it. I was in New Zealand later that year and discussed this with the scientists who investigated it and have written on it. However, the following account is worth quoting at length because of the many issues important that it raises.

> The most recent episode was an outbreak of “killer zucchini” which produced the “only food scare in recent history in New Zealand” and interestingly it “stemmed from the farmingmethods of organic farmers and others who use unconventional farming practices” (LSN2003). In February 2003, Zucchini with “high levels of natural toxins” was sold on the vegetablemarket and resulted in “several recorded cases of people suffering food poisoning” (LSN2003). We often worry about the toxicity resulting from spraying crops but rarely are we asconcerned about those from not spraying them.
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> An examination of common factors shows the levels of toxin apparently increased among zucchini growers who did not spray their crops. Unusual climatic conditions meant there were huge numbers of aphids about in January and insect predation is sometimes associated with increased levels of toxins in plants.
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> In this case, there was a “clear link between increased toxin levels and older open-pollinating varieties of seeds” (LSN 2003). It is another of the “inferior is superior” views that there is something inherently virtuous in farmers planting their own saved seeds but it is “likely zucchini grown from saved seed will therefore be more vulnerable to toxin build-up”.

The scientists who reviewed the “killer zucchini” case were very clear that the “most likely cause of the build-up of toxins is a genetic weakness in older varieties.” However worthy the farmer’s intentions may have been, “the growers’ decision to use older varieties and to save seeds is likely to have resulted in a health risk for consumers – something which has never happened with crops derived from genetic modification”.

In virtually every country in Asia and elsewhere in areas that benefited from the Green Revolution increases in wheat and rice and the increased yields from hybrid corn, the percent of land under cultivation to primary grains has actually been decreasing while the percent of land globally under cultivation to fruits and vegetables has increased substantially (more than tripled since 1980 by my calculations, closer to doubling by others). From 1980 to 2004, fruit production increased 3.6 percent per year and vegetable production increase 5.5 percent per year. Only 4 percent of this increase occurred in developed countries.

> The worldwide supply of fruits and vegetables per capita has increased continuously since 1961.” page 5, “Between 1970 and 2000, annual growth rates in vegetable yields have been impressive in South Asia (1.8 percent), Latin America and the Caribbean (1.7 percent) and East and Southeast Asia (1.6 percent). Twenty-five percent increase in fresh fruit and vegetable consumption in the USA between 1977 and 1999,

“Dangerous” chemicals in food?

I try in a small way to immunize my students against scare tactics by having a one class period devoted to some of the things that are in your food about which you would prefer not to know when you are eating it.

Finding a list of 10 or 15 or 20 of the supposed grossest things in your food is easy. Using a search engine will bring up more lists than you need or want. Most all the lists have a sub-text on the evils of modern food production.

Beware the rhetorical question from activists that is designed for you to give the answer that the questioner is seeking. I have a couple of my own. How about: Do you want rat poison in your children's milk? Well, yes, if it is a calciferol that provides vitamin D 2 (ergocalciferol) and vitamin D-3 (cholecaciferol) both of which are constituents of many rodenticides. The synthesis of this "rat poison" in the 1920s was one of the important medical advances of the time as it contributed to preventing rickets which was all too common at that time. It also allowed along with electric lighting for domesticated chickens to lay eggs all year long and was an essential element in raising egg production from an annual average of 83 per chicken in 1900 to the over 300 annual average today. We have all eaten dog poison, namely chocolate. Most of us if asked know that chocolate is lethal to our beloved pets but do not think of it in that way when we eat it.

What about ethyl butyrate in our orange juice or martinis? Now that is a chemical and it is used as a solvent in a number of products (nail polish remover) and also as a plasticizer in cellulose. In fact.the ethyl butyrate in your reconstituted orange was originally a natural constituent of the oranges themselves.

It is fun to send the students looking for what foods that they eat that have castoreum or cochineal in them. Castoreum comes from beaver's castor sac (often called an anal gland because of its proximity to the posterior) and is secreted (or an exudate) in the urine to mark a trail for the beaver. What could be more natural? Cochineal is a scale insect that is cultivated on cactus in Mexico and has been ground up and used as a food coloring for centuries by the Mayans.

Many food and chemical scare lists are from websites or groups that criticize modern food production for its alleged waste yet also criticize it for finding uses for the entire animal, finding ways to use parts that are not found appetizing in our culture. Some of these ingredients are constituents of what are prized in other cultures such as haggis among the Scots and blood sausages for the Argentinians. Being raised in New Mexico, I remember Rocky Mountain oysters with great affection. Or how about what has been identified as the roe or the "fully ripe internal egg masses in the ovaries, or the released external egg masses" of sturgeon — what that most of us know as caviar.

One activist site even criticized "cheese makers" for using "rennet derived from the mucosa of a veal calf's fourth stomach to create the beloved, versatile dairy product" a process used for making certain types of cheeses for several thousand years. Note that modern biotechnology has provided us with GM chymosin enzyme for rennet cheese which passes muster for vegetarians if they are not ideologically opposed to GMOs.

Processed food has become a code word for modern food evil. Could we not consider wine to be processed grapes and fine cheeses and yogurts and other delicacies as being processed milk?

One of the silliest complaints found spiraling through cyber space is the disdain for having chicken feathers or duck feathers or even human hair or cow horns in our bread and a variety of other products.

What many are getting excited about is the extraction of L-cysteine from these for various food and other uses. L-cysteine is an amino acid and therefore a nutrient. For infants and children and even some adults, it is an essential amino acid.

If the critics would calm their hysteria and think about it a minute, they would have to consider this one a challenged to hated “industrial agriculture.” Scientists have taken what would otherwise be a waste product (except maybe for stuffing pillows) and extracted a nutrient from it and added it to the food that we eat. Maybe the organizations and websites promoting these fears don’t want their followers to think about it. Ironically, some of those most vociferous about the “right to know what they are eating” are among the most ignorant of what is in their food or at least its significance.

Does industrial agriculture increase or reduce waste and food dangers?

One of the true achievements of modern science and agriculture is that it finds uses for so much of what is grown and thereby reduces waste. Waste such as not picking crops because they do not have an appearance that is saleable is a separate matter and is deplorable and is rightly condemned. Waste because in our affluence we overstock our refrigerators and then dispose of the inevitable spoilage is also deplorable particularly when there are still so many in hunger. But fuller utilization of what we produce is commendable.

Critics of biotechnology with zero knowledge or experience in agriculture often argue that we should attack world hunger by reducing waste rather than advancing new agricultural technologies. Some of us prefer to use all means at hand both by reducing waste, by increasing output and by seeing that those in need get their fair share. I actually had the good fortune of having someone make the reducing waste argument to me. He was blissfully unaware of the basic fact that farmers and others have been working on reducing post-harvest food loses everywhere and for as long as we have had agriculture.

Modern science and technology have in fact transformed the environment and converted waste into nutrients; it has transformed that which has harmed us into food stuff or medicine. The fungi claviceps purpurea produces a toxic, ergot, which infested grains such as rye and maize and has caused enormous pain called St. Anthony’s fire throughout human history. My wife and many others have taken ergot for relief from migraines. This is one of a number of cases where we have taken a poison and used it for medicine or a pain killer or anesthesia.

There are a whole raft of other truly disgusting things in the foods that we eat but you will not find them (with a very few exceptions) on the disgusting food lists because their being in our foods does not serve an anti-modern food production agenda. Rat feces or even bits of a rat itself in your cereal or toast or cookies are not pleasant thoughts when eating ones breakfast. One must not forget the multitude of insects and micro-organisms that “contaminate” the food that we eat. These and many more can be found in the USDA/FDA publication “Defect Levels Handbook: Levels of Natural or Unavoidable Defects in Foods that Present no Health Hazards for Humans**“.**

The phrase “Unavoidable Defects in Foods that Present no Health Hazards for Humans” says it all. They have been part of the food that we humans have eaten for as long as we have been eating. Some of the

micro-organisms in our foods produce highly harmful toxins if the dosage is high enough. The dirty little secret that our foodie activists ignore is that modern food production, storage, transporting and processing have reduced these harmful products to extremely small (but not to zero) manageable levels.

This has not always been the case as our progenitors often suffered mightily from them and as with the cases above with the fumonisins, many poor people today still suffer from them. When you discard a food item because it has become infested with a fungus, think of the poor subsistence family that has a choice of eating something similar or not eating at all. A quick search will turn up numerous articles in medical journals of the severe organ damage that can target those who eat contaminated food. Contrast with tolerance level measured in parts per billion in many foods of “industrial agriculture” that we are privileged to eat.

Food scares and GMOs

An ongoing myth is that the manufacturing of L-tryptophan,using a genetically-modified bacteria, was responsible for an epidemic of Eosinophilia-Myalgia in the United States in the 1980s. This enduring legend remains one of the enduring factoids of the anti-GM movement in spite of massive evidence to the contrary. To the believers, no explanation is required as to how the manufacturing transformed the L-tryptophan and what pathway or action in the human body would result in the condition of Eosinophilia-Myalgia. When presented with peer reviewed data in an email that demonstrated the pathway to Eosinophilia-Myalgia from overdosing on L-tryptophan, a guru of the anti-GMO movement responded that nothing in the article altered his opinion.

Most vitamins are either harvested from soybeans which are likely transgenic using hexane a potent solvent or manufactured by bacteria in huge vats in Japanese chemical companies, shipped to the U.S. in huge containers to factories where they are put in pill form in a bottle labeled all natural for a stand-alone vitamin that we mostly get as part of complex protei*ns.*

What about glyphosate?

A news article in Nature News once explored the possibility that pesticide glyphosate could possibly be used to treat malaria; in other words could it be a medicine? “Could malaria be killed by what is now used as a garden weed killer?” was the headline of the Hellen Phillips piece in Nature. The answer is “yes”, it is possible. Glyphosate might also be able to treat other diseases.

> The researchers have also found other shikimate-pathway enzymes in T. gondii and P. falciparum, each one a potential target for new drugs, and plan to try other new combinations of treatment. They have worked out the genetic sequences of a gene that produces one of these enzymes, which may turn out to be a powerful tool in the hunt for a ‘designer’ drug.
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> One real advantage of this approach to treatment will be for AIDS patients. Because the immune system of these patients is suppressed they often suffer from multiple opportunistic infections, including pneumonia and tuberculosis, as well as some of the apicomplexan infections. As all of these organisms also have the shikimate pathway, the researchers say

> “there is now the exciting possibility that compounds with broad-spectrum activity could be useful against several opportunistic pathogens” (Could malaria be killed by a garden weedkiller?

How could that be possible? Glyphosate works by disrupting the shikimate pathway in plants causing them to die. A plant’s metabolic process takes energy from the sun and uses it along with the plant nutrient to create among other things amino acids. The shikimate pathway is used by the plant for the biosynthesis of the aromatic amino acids including tryptophan which we discussed above. The shikimate pathway is also used by bacteria, fungi and algae but not animals. We humans and other animals get our amino acids from plants and other animals. Since we do not have to manufacture our amino acids (though we do transform them), it saves our energy for other uses. Plant photosynthesis using energy from the sun is the ultimate source of both our nutrients and the energy to use them.

In other words, what makes glyphosate toxic to plants and micro-organisms does not make it toxic to humans. One life forms poison may be another life forms nutrient or at least be neither. That does not mean that there might not be other toxic side effects for humans but that is an open question and not settled as many fervently believe. But it does mean that glyphosate has the potential of being medicine for the same reason it is a pesticide – it kills or retards the development of what harms the plants that we are trying to grow or kills or retards the growth of that which harms us.

The number of articles in reputable peer reviewed scientific journals strongly suggests that it may not be toxic to humans or at least not sufficiently toxic to offset possible benefits for disrupting the shikimate pathway of invasive organisms that harm. This is in line with the long standing ranking of the toxicity of glyphosate as being Group III: Unclassifiable as to carcinogenicity in humans, with Group I as posting the most risk).

[Read Part I here. To be continued in Part III] This blog, the second of three parts, appeared originally in Butterflies and Wheels with the title “A Pesticide as Medicine? Medicine as Poison? Or What is in a Name?” and can be seen in its original form here.

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