# A Pesticide as Medicine? Medicine as Poison?
## Or What is in a Name?
By Thomas R. DeGregori

What is in a name? Plenty! The mere hint or even question suggesting that a pesticide might have any medicinal value would strike many as being ludicrous while to many others if not most others, it is beyond belief and therefore there is no need to continue reading. PESTICIDES ARE POISON! They are inherently evil and any attempt to define them in any other way makes one a member of a corporate cabal or a servant of them. For those brave souls still reading, let us begin with a few definitions or concepts – over simplified but not incorrect.

Poison – disrupts a vital function or functions in a living organism or organisms that could lead to death but not necessarily so. There are many confounding factors including one's immune system and most important ~~in~~ for toxicology, the dose received and ~~which~~ the species exposed~~organism is attacked~~.

Toxin – essentially the same as poison but with some exceptions largely refers to a substance created by a plant or micro-organism, most often for defensive purposes.

Dose – The well-established principle of toxicology is ~~that~~ – ~~Dose~~ the dose makes the poison. Or as stated by Paracelsus (German speaking doctor, Swiss, Philippus Aureolus Theophrastus Bombastus von Hohenheim, 1493 – 1541) who is credited with the concept - All things are poison, and nothing is without poison; only the dose permits something not to be poisonous (in Greman - Alle Ding' sind Gift, und nichts ohn' Gift; allein die Dosis macht, daß ein Ding kein Gift ist). The demand of many for "zero tolerance" violates this basic principle of toxicology and is theology or ideology masquerading as "~~"~~ science protecting the public." For vital nutrients for humans, there are amounts below which result in deficiencies and above which are toxic, often with similar outcomes. Much the same is true for plants.

Medicine - For infectious diseases, medicine would largely be something that kills the living organism that causes the infection. In such instances, a medicine would be a form of poison. Medicine as an anti-biotic is simply the use of a toxin (poison) produced by another living organism, a fungus, bacteria or plant, to kill the living organism or organisms that have invaded the human body and are causing harm or possible death. In the last half of 19th century, with improved microscopes and aniline dyes, scientists could see into the cell and into the blood stream. Koch, Pasteur and others were able to identify the micro-organisms that caused some of the world's most deadly infections. With the dyes, one could not only identify the micro-organisms, but it was also clear that they responded differently to the dye than did the surrounding blood and tissue. Consequently, if a substance could be found that killed the micro-organism but not the human (or domesticated animal), it would be medicine.

NOTE – Dose makes the poison in medicine in more ways than one. Most everyone knows that not taking enough of a medicine might do more harm than good. For example – patients not completing a treatment for TB led to the emergence of more lethal drug resistant varieties of TB. Dose is also important in that the medicine can kill the infectious agent and also otherwise hurt the patient known as side-effects. The choice often is between either ~~letting~~ allowing the infectious agent to kill you or allowing the medicine to harm you while saving your life. (On a personal note – I had three of the deadliest infections known to humans. I gave up a leg to survive one of them. For the last of the three, I was being given antibiotics that damaged the kidneys – their more general use had been discontinued decades earlier because of that. The dosage was very carefully monitored as were my kidneys which were "badly" damaged up to the point but not beyond that which would allow the kidneys to recover~~.~~ To~~which to~~ my good

fortune, they did.) Medicine and poison are therefore relative terms both relative to the organism and a balance between benefit and harm. Chemotherapy in cancer treatment would be an excellent example of the balance between benefit and harm. Ironically, one could say it is a medicine if it is more likely to save you than kill you!

Pesticides - Poisons that could also be considered as plant medicines. (Are you still with me? Have I lost more of you?) In fact, in Indonesia where I worked, pesticides were known as obat - medicine – or obat pembunuh hama meaning medicine that kills disease. Designating a pesticide as medicine may seem preposterous or even insane to the urbanites in developed countries. It makes perfect sense to farmers in many developing countries. Their precious food crops (and other crops) have been regularly getting sick and dying for them and for those who came before them. If they now have something that kills what kills or harms their food crops and allows the plants to return to health, it is medicine in every reasonable sense of that term.

A pesticide as medicine for plants operates with similar constraints as medicine for humans. A pesticide must kill or damage that which is bringing harm to a crop, be it a micro-organism, an insect, rodent or another plant competing with the crop for nutrient including light. As with other medicine, a pesticide has to do no harm to the crop or at minimum less harm than that with which it is afflicted. A pesticide has any number of other constraints such as not harming non-target species, such as other desired plants, beneficial insects and of course humans. In other words, pesticides must kill a targeted insect or weed without otherwise reducing a desired condition of biological diversity. Like antibiotics for humans, pesticide use must have a strategy killing targeted micro-organisms, insects or weeds in a manner that minimizes their ability to develop resistance to it.

With or without pesticides, a farmer has to find ways of protecting her or his crop. The more successful agriculture is, the more it concentrates nutrient in an open field. (We will obviously neglect greenhouses and hydroponics for this note though they are not without problems including invading organisms.) Nutrient for humans is likely to be nutrient for a host of other creatures (but not all) including birds, rodents, other wild animals, insects, micro-organisms etc. and be grown in soil with nutrients that supports competitive plants. One way or another, the crop has to be protected. Farmers have been doing this for thousands of years and it has often been with arsenic and other toxins that afflict the target species but are also toxic to humans and a range of other creatures. Many like Michael Pollan seem to believe that the use of pesticides was an invention of modern agriculture (identified as industrial monoculture) which requires its use while agriculture as traditionally practiced did not.

It is naïve in the extreme to believe that organic farmers do not use pesticides as farmers always have. The USDA has “The National List of Allowed and Prohibited Substances” for organic agriculture (http://www.ams.usda.gov/AMSv1.0/NOPPetitionedSubstancesDatabase ) which includes both “natural” and synthetic pesticides. Nor is there any evidence that natural pesticides are any safer or better than synthetic ones. A number of the pesticides used by organic farmers are also used by conventional farmers. In other words, natural pesticides have their uses, but if they were superior in every way, there would be no need for synthetic pesticides either in organic or conventional modern agriculture.

Most important among the non-target organisms that should not be harmed by a crop protecting pesticide are of course the humans who will apply the pesticides, those who harvest and later handle it and of course the eventual consumers who eat it. There are more short and long term considerations of pesticide use than we can even begin to discuss here, which not only complicates the issue but provides for an unending stream of discourse and debate. Rarely do we

discuss the problems of not using pesticides beyond that of losing the crop. Plants in the wild including those that were later domesticated by humans had to protect themselves. They did so by producing substances that are toxic to the organisms that threaten them. Plants were and remain chemical factories that produce a huge array of chemicals. The only choice for those who wish to avoid chemicals in their food ~~had better~~is to stop eating. In the fall term, just before Thanksgiving, I circulated a Holiday Menu provided by THE AMERICAN COUNCIL ON SCIENCE AND HEALTH (http://acsh.org/2008/11/acsh-holiday-dinner-menu/) listing some of the many chemicals in the foods that grace our table for the Thanksgiving and Christmas Holiday. (For nearly 30 years, I have served on various Boards for ACSH and am currently on the Board of Scientific Advisors.)

Humans through time in domesticating plants have selected through the centuries for matters like taste and yield. Many of these attributes selected for, particularly taste, ~~tend to lessen~~led to a lessening of a plant's ability to defend itself thus needing more defense from the farmer. Modern plant breeding including biotechnology has allowed for the creation of plants with improved defenses. Even so, plants remain chemical factories. Most plant toxins are secondary metabolites and are largely expressed when the plant is invaded. The greater the invasion, the greater will be the likely expression of toxins.

In recent years, it has been argued that organic produce has more nutrients than conventionally produced produce because they are less well protected. When offered by Michael Pollan, it places him on a slippery slope to a place where he does not want to go. First, most of the alleged increased nutrients are anti-oxidants for which there is no evidence of any benefit. In fact, there are a number of studies that show serious potential harm from too many anti-oxidants including one that shows increased risk of diabetes (http://www.sciencedirect.com/science/article/pii/S1550413109002575, ***Reactive Oxygen Species Enhance Insulin Sensitivity,*** *Cell Metabolism*, Volume 10, Issue 4, 260-272, 7 October 2009). Even more, Pollan in effect concedes a toxin or a poison is not necessarily an absolute and that what is toxic to one organism may be a nutrient to another. Another trick used to allege greater nutritional value for organic food is to pick a nutrient in a food which is a poor source for that nutrient. Thus an otherwise insignificantly small increase in that nutrient can be presented as a large percentage increase. A plane with a safety record of one in a million fatalities is twice as risky as one with a safety record of one in two million but few of us would seriously disrupt our travel schedule just to get the "safer" plane. There are a number of factors that could explain small differences in nutrients other than the ones that those dredging the data are seeking to establish as the cause.

Cherry picking nutrient increases because plants are less well protected ignores the other secondary metabolites also expressed that might not only be toxic to invasive organism but also to humans. As Bruce N. Ames and Lois Swirsky Gold have demonstrated in a number of peer-reviewed articles in major scientific journals (for example - http://toxnet.nlm.nih.gov/cpdb/pdfs/Paustenbach.pdf and http://ec.europa.eu/environment/ppps/pdf/ma_reding_annex2.pdf), 99.9% of the chemicals that humans ingest are natural but the dosage is sufficiently small as not to be dangerous in most cases.

The aptly named confirmation bias allows those convinced of a belief to find a nugget or two of evidence for their convictions in a mountain of data. Ignored are the large scale meta-studies that

find no significant difference in nutritional value between organic and conventionally grown food.

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"**Results:** From a total of 52,471 articles, we identified 162 studies (137 crops and 25 livestock products); 55 were of satisfactory quality. In an analysis that included only satisfactory quality studies, conventionally produced crops had a significantly higher content of nitrogen, and organically produced crops had a significantly higher content of phosphorus and higher titratable acidity. No evidence of a difference was detected for the remaining 8 of 11 crop nutrient categories analyzed. Analysis of the more limited database on livestock products found no evidence of a difference in nutrient content between organically and conventionally produced livestock products.

**"Conclusions:** On the basis of a systematic review of studies of satisfactory quality, there is no evidence of a difference in nutrient quality between organically and conventionally produced foodstuffs. The small differences in nutrient content detected are biologically plausible and mostly relate to differences in production methods"

( **Nutritional quality of organic foods: a systematic review,** The American Journal of Clinical Nutrition, vol. 90 no. 3, **September 2009, pp. 680-685. See also** Are Organic Foods Safer or Healthier Than Conventional Alternatives? : A Systematic Review, **Annals of Internal Medicine,** Vol. 157. No. 5, September 4, 2012).

The other question is – are they safer. As we will attempt to show below, there is reason to believe that organic agriculture produces a less safe product.

"The Bt. protein in transgenic Bt. corn is toxic to insects with a base digestive and receptors for the toxin but not necessarily to humans who eat the corn where the Bt. toxin, a protein is broken down to its constituent amino acids in our acid based digestive system. Certain proteins in tree nuts that can be fatal to some human beings are simply nutritious proteins to other human beings. There is considerable literal truth to the adage that one man's meat is another man's poison. There is ongoing international research on proteins that are allergenic to humans.
(See for example - **Protein Allergenicity Technical Committee (PATC),** ILSI Health and Environmental Sciences, Institute, **http://www.hesiglobal.org/i4a/pages/index.cfm?pageid=3317** )
Researcher encountering a novel protein can consult the descriptions of known allergens for similarities. And they can conduct allergenicity tests on it.
Given that increasing yields has allowed more corn to be grown on less land there by leaving more land to return to forests or other vegetation, Bt. corn and other Bt. crops have provided an environmental benefit as has the overall land sparing ability of modern agriculture. Though there is not a scintilla of evidence for any harm from the Bt. corn crop to non-target insects, to the environment or to humans, there is considerable evidence that the crop product itself is safer.

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When the Corn borer works its way into the corn plant, it will carry a fungus, Furarium ear rot into the plant. Simply the act of breaching the plant's outer defenses makes it more susceptible to disease invasion. The fusarium ear rot express neurotoxins called fumonisins. The Bt. protection reduces considerably any fusarium infestation of the corn crop
(Munkvold GP & Hellmich RL (1999) Comparison of fumonisin concentrations in kernels of transgenic Bt maize hybrids and nontransgenic hybrids." By Gary P. Munkvold, Richard L. Hellmich, and Larry G. Rice, Plant Disease, Vol. 83, No. 2, February 1999, pp. 130-138).

Fumonisins Disrupt Sphingolipid Metabolism, Folate Transport, and Neural Tube Development in Embryo Culture and In Vivo: A Potential Risk Factor for Human Neural Tube Defects among Populations Consuming Fumonisin-Contaminated Maize by Walter F. O. Marasas, Ronald T. Riley, Katherine A. Hendricks, Victoria L. Stevens, Thomas W. Sadler, Janee Gelineau-van Waes, Stacey A. Missmer, Julio Cabrera, Olga Torres, Wentzel C. A. Gelderblom*, Jeremy Allegood, Carolina Martínez, Joyce Maddox, J. David Miller, Lois Starr, M. Cameron Sullards, Ana Victoria Roman, Kenneth A. Voss, Elaine Wang and Alfred H. Merrill, Jr. Journal of Nutrition The American Society for Nutritional Sciences, 134:711-716, April 2004. http://jn.nutrition.org/cgi/content/full/134/4/711

"State and national investigators would eventually find that Brownsville had an astonishingly high rate of anencephaly, as the condition is called. From 1989 through 1991, 32 women in this town of 130,000 carried anencephalic babies. Many of the children died within hours, and all within days, of birth. ... From the beginning, many residents suspected the pesticides that armor nearby fields of cotton and sorghum. Others blamed the chemicals that waft from industries along the Rio Grande. Some parents of affected infants even shared a $17 million settlement from more than 80 maquiladoras - U.S. factories hugging the Mexican side of the river - in 1995. ... But now, state health officials wonder whether the culprit was not man-made, but a natural fungus that can cling to corn. The fungus makes a toxin, called fumonisin, unknown to science until 1988. ... Fumonisin (pronounced few-MAHN-i-sin) is spit out by the mold Fusarium as part of its chemical defense system. For decades, farmers and ranchers have known that animals can fall seriously ill if they eat corn that has been coated with Fusarium, even if the kernels later seem clean. People in parts of the world with high Fusarium growth, most notably the Transkei region of South Africa, have high rates of esophageal cancer. But it wasn't until 1988, when South African scientists first described fumonisin, that anyone knew exactly why the mold was dangerous. ... "

(Corn toxin examined in border birth defects - Diet may have put Hispanics at risk By LAURA BEIL / The Dallas Morning News Saturday, February 4, 2006.
http://www.dallasnews.com/s/dws/news/longterm/stories/020506dnprocorntoxin.6ec7933c.html
See also Exposure to Fumonisins and the Occurrence of Neural Tube Defects along the Texas–Mexico Border by Stacey A. Missmer,[1,2] Lucina Suarez,[3] Marilyn Felkner,[3] Elaine Wang,[4] Alfred H. Merrill, Jr,[4] Kenneth J. Rothman,[5] and Katherine A. Hendricks Environmental Health Perspects, Vol. 114, No. 2, February 2006, pp. 237–241. And Bt corn reduces serious birth defects by Bruce Chassy and Drew Kershen, Western Farm Press, October 27, 2004)
The concern over the Bt. Is a subset of the obsession, some might legitimately call it hysteria over the safety of transgenic using recombinant DNA (rDNA) to produce agricultural crops, particularly food plants generally called genetically modified or GMOs. It is easier to scare people than educate them. Need a new term for some forms of ignorance that is less pejorative. In the vast array of human knowledge, the best any one of us can do is to master small portion of it. In another words, all of us are uninformed or ignorant or at best minimally informed about all the rest of knowledge. True ignorance is when an individual or group has an absolutely unshakeable conviction on a subject such as agricultural biotechnology about which they know nothing and even worse, about which they are certain that they know is egregiously in error. Ignorance is the one crop, the lucrative cultivation of which anti-GMO NGOs have mastered

even though they may not have raised any other crops or done anything to help feed people. Financial nutrient for the organization seems to take precedence over nutrition for real people.

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. P*otatoes* 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 (Killer Zucchini. Life Sciences Network, 2003. http://www.lifesciencesnetwork.com/news-detail.asp?newsID=1122). . 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 raiseses.

> "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 farming methods of organic farmers and others who use unconventional farming practices" (LSN 2003). In February 2003, Zucchini with "high levels of natural toxins" was sold on the vegetable market and resulted in "several recorded cases of people suffering food poisoning" (LSN 2003). We often worry about the toxicity resulting from spraying crops but rarely are we as concerned 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 (LSN 2003).
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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" (LSN 2003).
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> "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" (LSN 2003)."

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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 % of land under cultivation to primary grains has actually been decreasing while the % 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 increase 3.6% per year and vegetable production increase 5.5% per year. Only 4% of this increase occurred in developed countries. (World Development Report 2008: Agriculture for Development, World Bank, page 58, and Horticulture for Poverty Alleviation - The Unfunded Revolution, AVRDC - The World Vegetable Center, 2005, http://www.avrdc.org/pdf/WP15.pdf , page 3 -"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%), Latin America and the Caribbean (1.7%) and East and Southeast Asia (1.6%)." page 9, "25% increase in fresh fruit and vegetable consumption in the USA between 1977 and 1999,"

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. The general tenor of the class is a big loud so what? –If in fact the disgusting things in your food improve it in any way either by appearance, taste or texture then so what? And of course, if there is no harm from eating it then again, so what? 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 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 vitaminD-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~~ tagged along with electric lighting for domesticated chickens to lay eggs all year long and was an essential element in raising egg production from an average of 83 per chicken in 1900 to the over 300 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 and also as a plasticizer in cellulose. 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 of these 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 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 except that most of us know it as caviar.

One 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. 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 cypher 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 plus for the hated "industrial agriculture." They 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.

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. When I asked him what forms waste takes in poor countries takes, he did not know but was sure that was what he wanted to work on. In reality, he wanted to dictate how and what those actually working on issues of hunger would do.

A favorite rhetorical question uttered by anti-biotech activists is do you want a virus in the DNA of the GM food that you eat? This is raised because as part of the transgenic process small viral segments have been inserted into some plant DNA. Little do they know that through the history of life on this planet, viruses have found a convenient way of replicating themselves by simply becoming part of the invaded organism. As much as 2/3rds of the human genome consists of whole viral sequences or recognizable parts of them.

Modern science and technology have in fact transformed the environment and converted waste into nutrient, 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

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. Friedrich Nietzsche's famed quote – generally translated as "That which does not kill us makes us stronger." Probably has more truth than Nietzsche himself may have realized. .

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 a 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 Defect Levels Handbook: Levels of Natural or Unavoidable Defects in Foods that Present no Health Hazards for Humans found at http://www.nal.usda.gov/nal_web/fsrio/fseddb/fseddbsearchdetails.php?id=1412 "This booklet includes the source of each *defect* and how the *defect* affects the food. The information is helpful as a quality control tool in food operations." Food and Drug Administration, Center for Food Safety and Applied Nutrition, http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/Sanitation/ucm056174.htm.
The tem 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 .As with the fusarium fumonisin mentioned above, 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 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 such as the Lancet of the severe organ damage to those who have little choice but to eat contaminated food. Contrast with tolerance level measured in parts per billion in many foods of "industrial agriculture" that we are privileged eat.
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 in an email that demonstrated the pathway to Eosinophilia-Myalgia from overdosing on L-tryptophan – a common practice at that time -, one of the leading lights, author, guru of the movement responded within an hour that nothing in the article – assuming the he read it? –altered his opinion. What more could you expect when your movement is represented around the world by a former ballroom dancing teacher with no training in science who believes that if a enough people in an area engage in something called "yogic flying," it creates an "harmonic convergence" that will lower the crime rate and raise the average intelligence.

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**A heretofore undisclosed crux of Eosinophilia-Myalgia**

**Syndrome: compromised histamine degradation**

**By M. J. Smith1 and R. H. Garrett2 Inflammation Research,** November *2005*, Volume *54*, Issue 11, pp *435-450*

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*.

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NOW BACK TO OUR TITLE - A Pesticide as Medicine?

Our question is asked in an news article in Nature news a week following an article in Nature that explored the possibility that pesticide Glyphosate could possibly be used to treat malaria in other words as medicine. Could malaria be killed by a garden weedkiller? Asks Helen Phillips in Nature News,( Volume 394, Number 6688, July 2, 1998, doi:10.1038/news980702-2) The answer, yes it is possible and also by the same understanding, Gly~~l~~phosate 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.

“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? By Helen Phillips, Nature News, Volume 394, Number 6688, July 2, 1998, doi:10.1038/news980702-2.)

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 form’s 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. 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~~Numerous articles in reputable peer reviewed scientific journals strongly suggest~~s~~ 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 type III in a ranking where type I is the

most toxic and type III (sometimes a Type IV is added) is the least toxic. I will leave it to those knowledgeable about the scientific issues to make any further assessments.
The following articles and the quotes from them might make some interesting reading for those who remain adamant that it is beyond the realm of belief that a pesticide could be anything other than a POISON.

Glyphosate **and AMPA inhibit cancer cell growth through inhibiting intracellular glycine synthesis by** Li Q, Lambrechts MJ, Zhang Q, Liu S, Ge D, Yin R, Xi M, You Z, Journal of *Drug Design*, *Development* and *Therapy*, Vol. 7, July 24, 2013, pp. 635-643

"This study provides the first evidence that glyphosate and AMPA can inhibit proliferation and promote apoptosis of cancer cells but not normal cells, suggesting that they have potentials to be developed into a new anticancer therapy."
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC89043/


Antimicrobial Agents Chemotherapy, Vol.43, No. 1, January 1999, Pp. 175–177.
Targeting the Shikimate Pathway in the Malaria Parasite *Plasmodium falciparum* By Glenn A. McConkey. Antimicrobial Agents Chemotherapy, Vol.43, No. 1, January 1999, Pp.175–177.

"The sensitivity to shikimate analogs suggests that the shikimate pathway is viable for malaria chemotherapy. The 50% inhibitory concentrations of these analogs are below those of some currently used antimalarial drugs (13). … Therefore, shikimate analogs may act as universal inhibitors of apicomplexan parasites, such as *Toxoplasma gondii* and *Cryptosporidium parvum*, which cause opportunistic infections in patients with AIDS."

"Based on the observations that mice were protected by 6-fluoro-shikimate from intraperitoneal bacterial infection (2) and that mice were cleared of *Toxoplasma* by treatment with a glyphosate-pyrimethamine formulation (13), the effectiveness of 6-fluoro-shikimate on malaria treatment awaits testing in rodent models."

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**Evidence for the shikimate pathway in apicomplexan parasites**
Fiona Roberts[1,2,3], Craig W. Roberts[1,2,3,4], Jennifer J. Johnson[3], Dennis E. Kyle[5], Tino Krell[6], John R. Coggins[6], Graham H. Coombs[6] Nature, Volume 393 Number 6687, June 25, 1998, pp 801-805.
"The discovery of the shikimate pathway in apicomplexan parasites provides new opportunities for the development of antimicrobial agents effective against these parasites. The inhibitor used in these studies, glyphosate, should be a valuable lead compound in this process. A variety of derivatives of glyphosate are currently being used to elucidate structure–function relationships for inhibitors of plant EPSP synthases[18], and a similar approach could be useful for characterizing the active site of the parasite enzymes. Inhibitors of chorismate synthase[19] and other enzymes within the shikimate pathway also are being developed in the search for new herbicides and antimicrobial agents effective against bacterial and fungal pathogens. These too may be useful against apicomplexan parasites. Indeed, because many other microbes that cause opportunistic infections of AIDS patients, including *Pneumocystis carinii*[20] and *Mycobacterium tuberculosis*[21], also have the shikimate pathway, there is now the exciting possibility that compounds with broad-spectrum activity could be useful against several opportunistic pathogens "

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Could malaria be killed by a garden weedkiller? By Helen Phillips, Nature News, Volume 394, Number 6688, July 2, 1998, doi:10.1038/news980702-2.

“The parasites that cause malaria, toxoplasmosis and cryptosporidiosis are all members of a group of microorganisms known as the Apicomplexa. This group of parasites kills well over one million people each year, and includes some of the most common opportunistic infections of AIDS patients. New medicines to treat these infections are needed urgently.

“In the 25 June 1998 issue of Nature one team of researchers describe how they are well on the way to finding such a treatment. The downfall of the Apicomplexa might turn out to be a common herbicide.

“A herbicide may sound like a strange treatment for a parasitic microorganism. But plants and many microorganisms share a common biochemical pathway that other living forms - notably humans - don’t have. An agent that disables this pathway will kill plants and microorganisms, but will be completely harmless to humans.

……..

“The researchers conclude that ‘such combinations should be useful for the treatment of toxoplasmosis. Furthermore, they could also have applications against other diseases caused by apicomplexan parasites, such as malaria.”

THE SHIKIMATE PATHWAY by Klaus M. Herrmann and Lisa M. Weaver, *Annual Review* of *Plant Physiology* and *Plant Molecular Biology*, Vol. 50, June 1999, pp. 473-503.

**Source**

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**Abstract**

“The shikimate pathway links metabolism of carbohydrates to biosynthesis of aromatic compounds. In a sequence of seven metabolic steps, phosphoenolpyruvate and erythrose 4-phosphate are converted to chorismate, the precursor of the aromatic amino acids and many aromatic secondary metabolites. All pathway intermediates can also be considered branch point compounds that may serve as substrates for other metabolic pathways. The shikimate pathway is found only in microorganisms and plants, never in animals. All enzymes of this pathway have been obtained in pure form from prokaryotic and eukaryotic sources and their respective DNAs have been characterized from several organisms. The cDNAs of higher plants encode proteins with amino terminal signal sequences for plastid import, suggesting that plastids are the exclusive locale for chorismate biosynthesis. In microorganisms, the shikimate pathway is regulated by feedback inhibition and by repression of the first enzyme. In higher plants, no physiological feedback inhibitor has been identified, suggesting that pathway regulation may occur exclusively at the genetic level. This difference between microorganisms and plants is reflected in the unusually large variation in the primary structures of the respective first enzymes. Several of the pathway enzymes occur in isoenzymic forms whose expression varies with changing environmental conditions and, within the plant, from organ to organ. The penultimate enzyme of the pathway is the sole target for the herbicide glyphosate. Glyphosate-tolerant transgenic plants are at the core of novel weed control systems for several crop plants. “