



Chlorinated
Pesticides

CHLORINATED PESTICIDES GUIDE



CHLORINATED PESTICIDES PROFILE INTERPRETIVE GUIDE

TABLE 1

Compound	CDC 50th		CDC 75th		CDC 90th		CDC 95th	
	ppb	ng/g lipid	ppb	ng/g lipid	ppb	ng/g lipid	ppb	ng/g lipid
DDE	1.26	203	3.16	509	7.07	1170	12.1	1860
DDT	<LOD	<LOD	<LOD	<LOD	0.078	11.9	0.128	19.5
Dieldren	<LOD	<LOD	0.059	9	0.098	14.4	0.138	19
Heptachlor Epoxide	<LOD	<LOD	<LOD	<LOD	0.094	13.4	0.128	18.9
Hexachlorobenzene	0.09	14.9	0.12	19	0.157	24.4	0.186	28.9
Mirex	<LOD	<LOD	<LOD	<LOD	0.054	8.4	0.093	13.2
Oxychlorthane	0.063	10.3	0.119	18	0.204	29	0.269	37.7
trans-Nonachlor	0.094	14.8	0.191	30.2	0.324	49	0.47	68.3

While there were many chlorinated pesticides used agriculturally and commercially in North America from the 1940s through the 1980s, the compounds measured in the Metamatrix Chlorinated Pesticide Profile are those most commonly found in persons tested today.

BENEFITS OF BOTH “PPB” AND “NG/G LIPID” VALUES

Levels of each of these pesticides are given as the total parts per billion (ppb) of each compound found in the serum and as a lipid adjusted value of nanogram per gram (ng/gram) of lipids in your blood (cholesterol and triglycerides) shown in Table 1. Ongoing studies the Centers for Disease Control (CDC) is conducting provide national reference values to compare test values for both measurements.¹ The levels reported in ppb are reflective of the amount of toxin present in the serum, mostly found in the cholesterol and albumin fractions.² Current exposures from air and food can also be detected in the serum.

All fat-soluble toxins are carried in the lipid fraction of the serum, mostly in low-density lipoprotein particles (LDL). Since levels of chlorinated pesticides change in direct proportion to blood lipid levels, improper test interpretations can result from examining only the concentrations in blood. Measurement of cholesterol and triglycerides in the blood serum from the same specimen used to perform the testing allows calculation of total

lipid level. The chlorinated pesticides concentrations can then be expressed as nano-gram per gram (ng/g) lipid. This method of correction has been shown to generate results that reflect adipose tissue levels of organotoxin compounds.⁵

The lipid-adjusted value gives a much more accurate picture of the total burden of these toxins that are residing in adipose tissue throughout the body.³ The amounts stored in adipose tissue are a result of bioaccumulation of these toxins over a lifetime. When lipolysis occurs (with fasting, exercise, stress, weight loss, and saunas), a portion of these toxins accompany the cholesterols and triglycerides that are released from the body's fat stores. By measuring the amount of lipids present in the blood and adjusting the amount of toxins to that lipid level, one is able to get a very accurate idea of just how much of those toxins are in storage. This interpretation allows individuals who are following any cleansing protocols to actually monitor their progress in reducing their overall burden of these persistent and accumulating toxins.

Also, by comparing the two values, one would be able to spot a current exposure more readily (high ppb in serum, but the lipid-adjusted values shows low or no stores of this compound).

TABLE 2: ORGANOCHLORINE COMPOUNDS IN THE SERUM OF 5994 PERSONS

Compound	Frequency of finding	Range
p,p-1-DDE	99.5%	>_1 ppb up to 378.6 ppb
p,p-1-DDT	10.5%	

WHAT TO EXPECT

Close to 100% of all persons will have p,p-1-DDE in their serum. In a study of 5994 individuals, researchers found that increasing age, residing on a farm, and being male brought increased risk for chlorinated pesticide burden.⁴ The levels of p,p-1-DDE found in this group are listed in Table 2.

The CDC mean levels of DDE are 1.57 ppb and 250 ng/gram of lipids. One can also readily see from Table 1 that, in addition to DDE, some will also have chlordane, oxychlordane, and trans-nonachlor. Dr. William J. Rea, at Environmental Health Center – Dallas, has stated, “when a person has more than one chlorinated pesticide present in their blood they already have some type of immunotoxicity effect present.”⁵

Metamatrix is using CDC values found in the Fourth National Report on Human Exposure to Environmental Chemicals to give the clinician a frame of reference when deciding if a patient has higher levels than what is found in the general population.

ADVERSE EFFECTS OF CHLORINATED PESTICIDES IN HUMANS

Chlorinated pesticides as a class kill pests primarily through their neurotoxic action by interfering with axonal transmission by disrupting ion flux. This reaction leads to overstimulation of the nerves with uncontrolled neuronal discharge. The acute toxicity (poisoning) signs and symptoms of these chlorinated compounds (headache, nausea, vomiting, hyperesthesias, irritability, confusion, convulsions, respiratory depression, cardiac arrhythmias, aplastic anemias, and porphyria cutanea tardias) are rarely seen as these compounds have mostly been banned from use since the 1980s. However, since these chemicals are fat-soluble and tend to bioaccumulate in animals and humans, they can cause a variety of health problems that often begin slowly. The effects of these compounds are most often seen secondary to mitochondrial toxicity in the neurological, immunological, and endocrinological

systems, although they can also affect the cardiovascular, respiratory, gastrointestinal, and other systems in the body.

All of these organochlorine compounds, with the exception of dieldrin, have been shown to induce the functioning of 1A and 2B cytochromes (which will increase the production of free radicals) and to also reduce glutathione levels, which are needed to clear the phase one metabolites out of the body.⁶

The adverse health effects listed under each analyte have been documented in the medical and scientific literature for that specific compound. Keep in mind that the health effects are very similar from analyte to analyte, many studies review several of these analytes, and many of the analytes have been found to be causative agents.

ANALYTES

DICHLORODIPHENYL-DICHLOROETHYLENE (DDE)

This DDT (dichlorodiphenyl-trichloroethane) metabolite is the most ubiquitous and abundant of all the chlorinated pesticides. When DDT is produced, it consists of a combination of both DDT and DDE (dichlorodiphenyl-dichloroethylene). The rate of breakdown in the environment (in temperate climates the soil half-life is 20-30 years) is measured by the changing ratios of DDE to DDT. Once in the human body, DDT is broken down to DDE within about six months. Many published research articles will use the term DDT or Total DDT which includes DDT, DDE, and DDD (dichlorodiphenyl-dichloroethane). Since DDE is the most commonly found DDT compound, the main aspects of all the DDTs will be reviewed under DDE.

DDT was first synthesized in 1874; its pesticide abilities were found in 1939, and it was used in wartime to control typhus and malaria. DDT was put into agricultural use in the United States in 1945 and was banned for use in 1972. However, production in the US was not banned, so DDT was still manufactured and sent to other countries, often as

part of US agricultural aid. The DDTs are found throughout the globe, including the Arctic and Antarctic, because trade winds have carried them throughout the planet.

The DDTs are highly fat-soluble and are stored in all of the lipid-rich tissues of the body including adipose tissue, the liver, and the brain. It has been estimated that 1 ppb DDT in serum would mean 5-10 ppb in brain, 47 ppb in liver, and 100-300 ppb in fat cells. DDE has been found in all samples of breast milk across the globe. Unfortunately, the level of DDE in some of these breast milk samples has exceeded allowable amounts in commercially-sold milk products.

EXPOSURE SOURCES

The major source of exposure is through dietary sources. From 1986 to 1991, the average adult in the United States consumed an average of 0.8 micrograms of DDT a day. The largest fraction of DDT in a person’s diet comes from

meat, poultry, dairy products, and fish, including the consumption of sport fish. A number of fresh water fish advisories have been posted in certain US lakes and rivers because of DDT contamination of trout and other fish. Leafy vegetables will often contain more DDT than other vegetables, possibly because DDT in the air is deposited on the leaves. All children are exposed while growing inside their mother’s womb and through breast milk after they are born.

The most recent Total Diet Survey⁷ assessment of DDE in food reveals that DDE is clearly one of the most commonly present toxins in foods. Table 3 shows those foods in which DDE was commonly found in the FDA survey. In each percentage grouping, the foods are listed with the most contaminated foods first.

TABLE 3: FDA TOTAL DIET SURVEY		
Food	Percentage of samples positive for DDE	Mean concentration of DDE in parts per million (ppm)
Catfish (farm raised)	100%	.032
Butter (non-organic)	100%	.02
Spinach (non-organic)	100%	.01
Salmon steaks (farmed Atlantic)	100%	.008
American cheese, processed	100%	.006
Cream cheese	100%	.004
Candy bar, chocolate, nougat, nuts	100%	.001
Quarter-pound cheeseburger	98%	.004
Meatloaf (homemade)	98%	.002
Quarter-pound burger	98%	.002
Lamb chops	95%	.005
Sour cream	93%	.0028
Fast food egg, ham, biscuit breakfast	93%	.0024
Pizza, pepperoni	93%	.0012
Ground beef	91%	.002
Pizza, cheese	90%	.0015
Collard greens, non-organic	89%	.0045
Hot dogs	89%	.002
Half and half	82%	.002
Vanilla ice cream	80%	.0012
Lasagna, beef	80%	.0008
Cheddar cheese	77%	.003
Peanut butter, creamy	75%	.0016
Baked potato, with peel (non-organic)	73%	.0013

Ten foods with the highest mean concentration of DDE, according to the TDS study:

1. Catfish (farm raised)
2. Butter (non-organic)
3. Spinach (non-organic)
4. Atlantic salmon
5. American cheese
6. Lamb chops
7. Collard greens (non-organic)
8. Cream cheese (non-organic)
9. Quarter-pound cheeseburger
10. Cheddar cheese (non-organic)

Other main sources of exposure would be from the dust or dirt in a home that was contaminated with DDE. This contamination could occur in an older dwelling where DDT was used, or in newer housing projects that were built on or around previously contaminated soil. These levels can also come from airborne contamination of DDE/DDT when it is used agriculturally in other parts of the world and makes its way across the globe on the trade winds.

Sport fishing is another potential source of DDT exposure for those persons who consume their catch. The Department of Fish and Game in the state the fish is caught will have advisories for any toxic presence in their waterways. Anyone who is planning on fishing in any state, including coastal waterways, should research this information before feasting on their catch.

ADVERSE HEALTH EFFECTS

In general, DDE causes ongoing neurological problems (including cognitive difficulties, headaches, and depression) along with immune and endocrinological problems. Various cancers are also associated with DDE presence. Breast cancer is not listed below because there have been and continue to be conflicting reports on the correlation between DDE and breast cancer. Although one intriguing study reported that if the DDT exposure occurred before the age of 14, those women had higher rates of breast cancer.⁸

- Prenatal exposure to DDE led to increased findings of hyporeflexia⁹ and attention problems¹⁰ in infants, and caused a delay in mental and psychomotor development identifiable at the age of 13 months.¹¹ It also led to decreased cognitive skills that were still evident when the children became preschoolers.¹²

- Prenatal exposure to DDE, HCB, and dieldrin increases the risk of otitis media, and higher levels led to the otitis becoming recurrent.¹³
- Prenatal DDE exposure increases the rate of asthma in children (with the highest levels of DDE having a relative risk of 2.6).¹⁴
- DDE increases the rate of mast cell degranulation and increases risk of allergy and asthma.^{15,16,17}
- Elevated serum DDE significantly reduces mitogen-induced lymphocyte proliferation response¹⁸ resulting in cell-mediated immune deficiency and may increase the incidence of herpes zoster.¹⁹
- DDE (and other chlorinated pesticides) are found in higher levels of the substantia nigra in persons with Parkinsonism.²⁰ It also disrupts the transport of dopamine in the brain.²¹
- DDE and HCB are associated with Chronic Fatigue Syndrome.⁵⁹
- DDE is associated with higher rates of type 2 diabetes.²²
- DDE levels are associated with a 71% increased risk of developing testicular germ cell tumors.⁶⁴
- Persons with above-median levels of DDE (and other chlorinated compounds) may have increased risk of developing pancreatic cancer²³ and will lead to tremendously shorter survival times in persons with pancreatic cancer.²⁴
- DDE levels (below medial levels) were associated with a greatly elevated risk factor (3.2) for liver cancer.²⁵
- DDE levels almost doubled the risk (OR 1.9) for endometrial cancer.²⁶
- DDE and other environmental endocrine disruptors have also been associated with increased rates of precocious puberty.²⁷
- DDE showed a clear correlation with both preterm births and small-for-gestational-age babies.²⁸
- DDE was the most frequently found chlorinated compound in a study of infertile females and their male partners.²⁹
- DDE levels are also associated with multiple abnormalities in semen indices and sperm amount, motility, and quality.³⁰
- DDE can also lead to early menopause.³¹
- DDE levels are associated with greater risk of endometriosis and reduced functioning of their natural killer cells.³²
- DDE can lead to altered levels of thyroid hormones.³³

DICHLORODIPHENYL-TRICHLOROETHANE (DDT)

See above section on DDE. The sources are similar, except that DDT is present in much smaller quantities. The health problems are virtually the same.

The main difference is the frequency with which DDE and DDT are found and their respective levels. While a small amount of DDT will be found in the adipose tissue of almost everyone, it is rarely found in the serum. Due to the time it takes for DDT to be metabolized to DDE in the body, if DDT is found in the serum, it typically indicates current exposures (probably by foods) within the preceding six months.

In the Total Diet Survey⁷ the greatest source of DDT is non-organic spinach.

DIELDRIN

From the 1950s until 1970, dieldrin and a similar compound aldrin were used extensively as insecticides on crops such as corn and cotton. They were both approved by the EPA in 1972 for killing termites and were used as termiticides until 1987. Aldrin is metabolized into dieldrin after entering the body or the environment (where sunlight and bacteria bring about the production of dieldrin). Dieldrin does not break down in water and is not easily volatilized to release into the air. It sticks very strongly to soil, sediment, and dust particles. It can be taken up by plants and stored in their leaves and roots. Fish or animals that eat dieldrin-contaminated materials store a large amount of the dieldrin in their fat. Animals or fish that eat other animals have levels of dieldrin in their fat many times higher because of bioaccumulation. Humans, who are at the top of the food chain, will then be the final repository for dieldrin.

EXPOSURE SOURCES

The most common exposures to aldrin and dieldrin occur from contaminated foods including fish or shellfish from contaminated lakes or streams, root crops, dairy products, and meats. Exposure to aldrin and dieldrin also occurs through water, air, or contact with contaminated soil at hazardous waste sites (check for these at www.epa.gov). People with the greatest potential for exposure include those who live in homes that were once treated for

termites using aldrin or dieldrin – exposure to these toxins can still occur years after they were applied in a home.

Squash, cucumber, and zucchini plants have the ability to clean aldrin and dieldrin from the soil and accumulate it in their fruits – which we typically eat.³⁴ These plants are reflected in the ten foods listed in the TDS⁷ as having the highest levels of dieldrin. Even if they are grown organically, if either aldrin or dieldrin is still in the soil from decades earlier, these organic vegetables will still have high levels of these toxins. Of course, these plants can also be used to clean the soil of these pesticides, it is just not recommended to either eat their fruits or to compost them.

Ten foods with the highest mean concentration of dieldrin, according to the TDS study:

1. Summer squash (0.007 ppm)
2. Hubbard squash (0.005 ppm)
3. Dill cucumber pickles (0.004 ppm)
4. Sweet cucumber pickles (0.003 ppm)
5. Raw, peeled cucumbers (0.003 ppm)
6. Pumpkin pie (0.0024 ppm)
7. Atlantic salmon (0.002 ppm)
8. Cream cheese (0.0008 ppm)
9. Creamy peanut butter (0.00076 ppm)
10. Cheddar cheese (0.0007 ppm)

ADVERSE HEALTH EFFECTS

- Disruption of dopamine transport in the brain.³⁶
- Dieldrin increased oxidative damage in the brain (nigrostriatal pathway)³⁵, and may lead to increased rates of Parkinsonism.³⁷ It is also significantly associated in persons already diagnosed with Parkinsonism.
- Dieldrin is associated with increased rates of hypothyroidism.³⁸
- Dieldrin adversely affects the Leydig cells reducing their production of testosterone and could contribute to infertility.³⁹
- Dieldrin is associated with increased rates of lung cancer⁴⁰, breast cancer⁴¹, and non-Hodgkin's lymphoma (NHL)⁴⁷.
- Dieldrin may also increase pancreatic cancer mortality.⁴²
- Dieldrin increases superoxide production and causes neutrophil inflammation.⁴³

HEPTACHLOR EPOXIDE (HCE)

Heptachlor, and its metabolite Heptachlor Epoxide (HCE), are chlordanes, a group of chlorinated compounds that were used agriculturally until 1974 and as termiticides commonly throughout North America until 1988. Bacteria in the soil, as well as the livers of humans and animals, will transform heptachlor through cytochrome 1A1 (Phase 1) to the much more toxic and biologically persistent epoxide form. Once a house has been treated with chlordane, the chlordanes can be found in the dust for the life of the home, contaminating anyone living in the home who is breathing the dust. Heptachlor is still approved for the treatment of fire ants in underground transformers.

EXPOSURE SOURCES

A major source of exposure is living in a home (built before 1988) in which the chlordanes were applied in the crawl-space under the house where furnace or air conditioning ducts are now located. If those ducts have leaking connections (common in older duct work), the chlordane contaminated dust will be sucked into the pipes and distributed throughout the house (no matter what grade of filter you have on the furnace – because this contamination occurs post-filter). Since heptachlor and HCE are very sticky to the soil and dust, another source comes from tracking dirt in from the outdoors. In many areas of the country, former orchards and farmland have now been turned into housing developments. Those areas where heptachlor was used before 1974 can have soil contaminated with HCE which will make it into the dirt and dust of the home. This contamination will be especially true in homes where shoes are worn indoors and that have wall-to-wall carpeting.

The next greatest source of exposure is through foods, typically sea foods, dairy, meats, and poultry. In the Total Diet Survey⁷, the foods that were highest in heptachlor epoxide are very similar to those in which hexachlorobenzene (HCB) was found. 50% of the butter samples (non-organic) had HCE. HCE was also found in 34% of all samples of cream cheese and salmon steaks (Farmed Atlantic Salmon), 32% of all samples of ground beef, and 30% of all samples of Swiss and cheddar cheeses. Interestingly, 25% of all samples of Hubbard squash also contained HCE.

Chlordanes have been found in all studies of breast milk in North America. Therefore, breastfed children have had both transplacental transfer of chlordanes and breast milk exposure.

ADVERSE HEALTH EFFECTS

- HCE, as the epoxide form, is a powerful pro-oxidant and difficult to clear through normal phase two functioning.
- High maternal levels of HCE lead to increased rates of cryptorchidism in their male offspring.⁴⁴
- HCE has demonstrated the ability to be an initiator, promoter, and progressor of breast cancer.^{45,46}
- Higher HCE blood levels give increased risk of NHL (third quartile levels give an OR of 1.82, fourth quartile levels have an OR of 3.41).
- HCE is neurotoxic to the dopaminergic system and may lead to increased risk for Parkinsonism.⁴⁸
- HCE presence, along with other chlorinated compounds, can lead to increased atherosclerosis.⁴⁹

HEXACHLOROBENZENE (HCB)

HCB is a by-product in the manufacturing of chemical solvents, other chlorine-containing compounds, and pesticides. Small amounts of HCB can be produced by combustion of waste and other compounds. It is also an industrial by-product of the chlor-alkali and wood preservative industry. Hexachlorobenzene was widely used as a pesticide until 1965 but is no longer used commercially in the United States. HCB was also used as a fungicide for control of mold and fungi in cereal grains, primarily wheat. The CDC study did not find enough HCB in people to determine standards, so the presence of any levels of HCB is abnormal, and should be considered actionable.

HCB is the only compound in this test panel that was not found commonly in the CDC study. Other chlorinated pesticides that were not regularly found by the CDC were not included in this panel, but HCB was included because of its serious health effects when present.

TABLE 4: THE TOTAL DIET SURVEY⁷: FOODS POSITIVE FOR HCB

Food	Percentage of samples positive for HCB
Butter, non-organic	66%
Salmon steaks (farmed Atlantic)	50%
Lamb chops	41%
Ground beef	25%
American cheese, processed	18%

EXPOSURE SOURCES

The CDC estimates the average exposure to HCB from foods is 1 microgram per kilogram ($\mu\text{g}/\text{kg}$) of body weight. The Total Diet Survey⁷ shows the foods HCB is most commonly found in are from cows (see table 4). Higher levels in the blood may also be from industrial exposures or from living close to a waste facility. To help assess these exposure sources, one can utilize the database at www.scorecard.org and <http://www.epa.gov/epahome/commsearch.htm>.

ADVERSE HEALTH EFFECTS

- Diabetes risk is increased to an odds ratio of 4.5 with the presence of HCB.⁵⁰
- Childhood obesity is increased to an odds ratio of 2.5 – 3.0 with maternal serum levels of HCB.⁵¹
- Testicular cancer rates are higher in men (OR 4.4) whose mothers had high serum HCB levels.⁵²
- Reduction of total thyroxine (T_4) occurs with increased levels of HCB (T_4 dropped 0.32 mcg/dl per each unit increase [in ng/ml] of HCB).⁵³
- Increased rates of soft-tissue sarcomas and thyroid cancers in persons living close to industry that emitted HCBs.⁵⁴
- Porphyria with neurologic manifestations.⁵⁵
- Increases risk for childhood otitis media to an OR of 2.38 when present with DDE.⁵⁶
- Increased risk for Epstein Barr Early Antigen and risk for non-Hodgkins lymphoma (OR 5.3 with 'above median' levels of HCBs).⁵⁷
- May be related to increased risk of autoimmunity.⁵⁸
- Chronic fatigue syndrome patients have higher levels of HCB and/or DDE.⁵⁹
- Suppresses gamma-interferon production.⁶⁰

OXYCHLORDANE

Oxychlordane is the major metabolite of the various chlordane and nonachlor compounds that were used agriculturally until 1974 and residentially until 1988. It is one compound found commonly in all persons living in North America that have been measured for levels of persistent pollutants in their blood. As a human metabolite it has not been found in food, since it will be produced by the liver after the individual is exposed to chlordanes and nonachlors through air, water, or food. This metabolite is, unfortunately, about eight times more toxic than its parent compounds and is more bioaccumulative.⁶¹

EXPOSURE SOURCES

See section on HCE, as all the chlordanes were often present together in whatever mixture was used agriculturally or residentially.

ADVERSE HEALTH EFFECTS

- Increased risk of diabetes (OR 14.7) with high levels of oxychlordane.⁶²
- Increased risk of NHL (OR 2.68).⁶³
- Increased risk (OR 1.63) for seminoma (testicular germ cell tumor).⁶⁴
- Increased risk of prostate cancer.⁶⁵
- Immunosuppression of cell-mediated immune response to pathogens.⁶⁶
- Decreased natural killer cell ability to lyse tumor cells.⁶⁷
- Increased likelihood of developing erectile dysfunction.⁶⁸

MIREX

Mirex was used as a pesticide to control fire ants, mostly in the southeastern part of the United States, until 1978. It was also used as a flame retardant additive under the trade name Dechlorane® in plastics, rubber, paint,

paper, and electrical goods from 1959 to 1972. Mirex is found attached to soil and dust like many of these other compounds. Once in the bloodstream, mirex is carried to many parts of the body where it is stored, mainly in fat. Mirex is not broken down in the body by the biotransformation processes.

EXPOSURE SOURCES

The most likely way for people in the general population to be exposed to mirex is by eating food, particularly fish, taken from contaminated areas. Currently, three states (Ohio, New York, and Pennsylvania) have issued a warning to the public that fish (primarily fish caught in Lake Ontario) may contain mirex. The Total Diet Survey⁷ has not measured other foods for mirex, so exposure sources are not clearly delineated.

ADVERSE HEALTH EFFECTS

In rodents, mirex causes liver, adrenal, and blood cancer. In humans it causes trembling, tiredness, weakness, increased oxidative damage, and neurological and immunological problems. Most of the published studies that look for adverse health effects of mirex are conducted while looking at a number of chlorinated compounds. As a single agent, it has not been well studied, so there are no specific articles listed in the references section.

TRANS-NONACHLOR

This analyte is another of the major chlordane compounds that was used agriculturally from 1953 to 1974 and as a termiticide until 1988.

EXPOSURE SOURCES

The same exposure sources listed for the other chlordanes also apply here. The most likely source will be exposure to dirt or dust that is already contaminated. Be especially wary about homes built before 1988 that have the original ductwork still intact. Unfortunately, there were a number of individual homeowners who chose to apply the chlordane themselves, and in these cases the chlordane may be inside the home.

Dietary sources of trans-nonachlor were surprisingly few in the Total Diet Survey⁷ with the most frequent finding being in sweet cucumber pickles (around 25% of all samples)

rather than dairy and beef like the other chlordanes. Trans-nonachlor is found in most persons who are tested for it.

ADVERSE HEALTH EFFECTS

The adverse effects of the chlordanes are all very similar.

- Many cancer and other health associations are found with trans-nonachlor, just in differing levels.
- Increased obesity and risk of diabetes, with the highest odds ratio of all of the organochlorine compounds for diabetes at 37:7!⁶⁹

THE PRESENCE OF MULTIPLE CHLORINATED PESTICIDES

Most of the studies that are used as references in this guide, and that have been placed under one or more of the individual analytes, actually reviewed multiple chlorinated compounds. Some of these studies show synergism while others show adverse health effects due to the total load of toxins. Other studies not referenced here are available readily on PubMed (<http://www.pubmed.com>)

ACTION STEPS

1. Identify exposure sources and remove them.
2. Enhance the clearance of persistent toxins from the body with cleansing protocols. Sauna therapy and colonic irrigations have been used to reduce the presence of PCBs and chlorinated pesticides.⁶⁹
3. Increase the normal bowel excretion of the fat-soluble toxins. Daily use of rice bran fiber (RBF) has been documented in several studies in Japan to increase the clearance of PCBs.⁷⁰⁻⁷² Chlorophyll and all chlorophyll containing foods are also tremendous at increasing the excretion of these fat-soluble persistent toxins in the feces.⁷³⁻⁷⁵ Increasing these foods in the diet, or with supplementation on a daily basis, will slowly increase the excretion of these compounds from the body. In addition to the chlorophyll containing agents, polyphenols found highest in white and green teas have been shown to increase the excretion of fat-soluble toxins.⁷⁶
4. Supplement with high amounts of a combination nutrient and botanical antioxidant to protect the tissues and cells that are under assault from the toxic compounds.

Action steps continued on next page

5. Assess detoxification ability with organic acid analysis, amino acid analysis, and genetic predisposition testing. These tests can aid in designing appropriate detoxification protocols for patients.

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