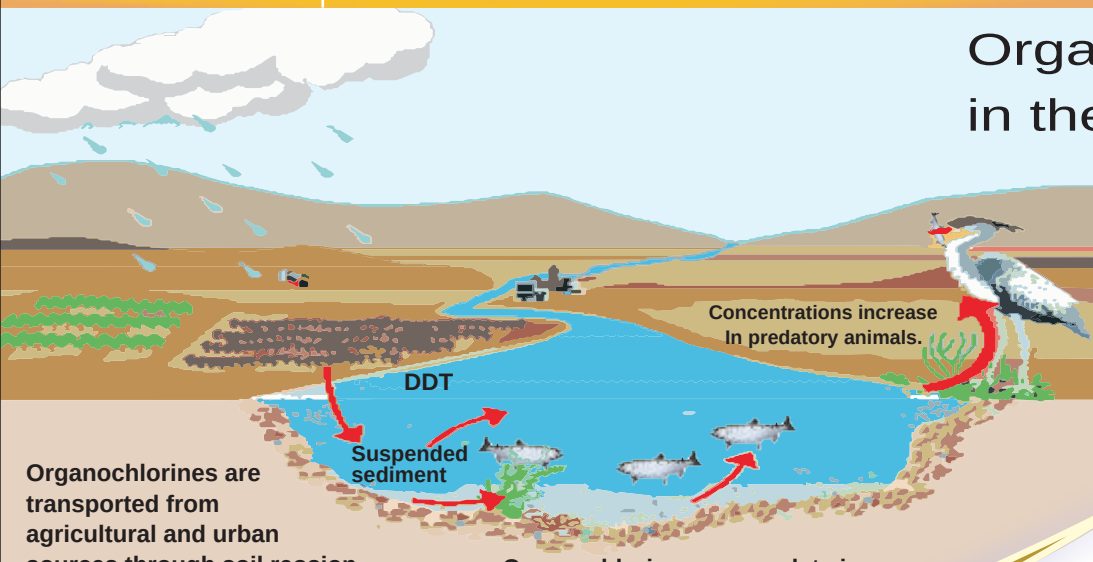
ISSN No. : 0972-1266

ENVIS Newsletter

Vol. 18 | No. 2 | May 2011

Organochlorines in the food chain



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IN THIS ESSUE

EDITORIAL

Organochlorine pesticides are insecticides composed primarily of carbon, hydrogen, and chlorine. They break down slowly and can remain in the environment long after application and in organisms long after exposure. The most notorious organochlorine is the insecticide DDT (Dichloro diphenyl trichloroethane). Promoted as a "cure all" insecticide in the 1940s, DDT was widely used in agricultural practices around the world for many years. It was also the chemical of choice for mosquito control. DDT was banned in many countries in the 1970s. Commonly known organochlorines that have been banned in the U.S. include aldrin, dieldrin, toxaphene, chlordane and heptachlor. Others that remain in use include lindane, endosulfan, dicofol, methoxychlor and pentachlorophenol. Organochlorines contribute to many acute and chronic illnesses. Symptoms of acute poisoning can include tremors, headache, dermal irritation, respiratory problems, dizziness, nausea, and seizures. Organochlorines are also associated with many chronic diseases. Studies have found a correlation between organochlorine exposure and various types of cancers, neurological damage (several organochlorines are known neurotoxins), Parkinson's disease, birth defects, respiratory illness, and abnormal immune system function. Many organochlorines are known or suspected hormone disruptors, and recent studies show that extremely low levels of exposure in the womb can cause irreversible damage to the reproductive and immune systems of the developing fetus. Organochlorines are stable compounds that vapourise and can be carried by air currents to long distances. Eventually they condense and are deposited on land and water, particularly in cold climatic conditions. If they contaminate the food supply of animals, organochlorines become more concentrated as they move up the food chain. Its highest levels have been reported in species at the top of the food chain ie human beings, fish-eating birds and marine mammals. The dangerous pesticide endosulphan was used in the cashew plantations of Kasargod in north Kerala more than a decade. The pesticide was sprayed aerially in the plantation from 1978 to 2001, which resulted in serious after-effects including environmental and health hazards. The victims of the endosulphan have since been in the path of struggle, not only try to erase the bad marks the pesticide had sealed on their lives, but also to bring to light the harmful effects of the poisonous chemical. Social activists, environmental and human rights groups, etc joined their struggle to create awareness about the chemical. The struggle of the people of some villages in Kasargod gradually became the struggle of whole Kerala and now, the voice of the world as the pesticide is now banned.

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ODDS AND ENDS

Childhood obesity and environmental chemicals.

Childhood and adolescent rates of obesity and overweight are continuing to increase in much of the world. Risk factors such as diet composition, excess caloric intake, decreased exercise, genetics, and the built environment are active areas of etiologic research. The obesogen hypothesis, which postulates that prenatal and perinatal chemical exposure can contribute to risk of childhood and adolescent obesity, remains relatively underexamined. This review surveys numerous classes of chemicals for which this hypothesis has been explored. The authors focus on human data where they exist and also discuss the findings of rodent and cell culture studies. Organochlorine chemicals as well as several classes of chemicals that are peroxisome proliferator-activated receptor agonists are identified as possible risk factors for obesity. Recommendations for future epidemiologic and experimental research on the chemical origins of obesity are also given.

[Mt Sinai J Med. 2011 Jan-Feb;78(1):22-48.]

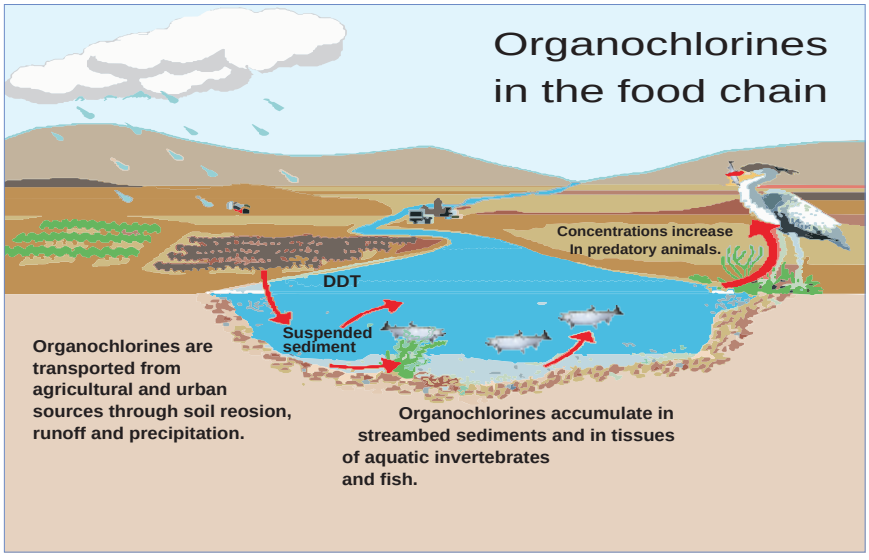
Level of organochlorine pesticide residues in dry fruit nuts.

The use of pesticides on cash crops and exportable food commodities had always been a serious concern. Fruits form one of the important constituents of human diet, in that they give one third of the requirement of calories, vitamins, and minerals. This study has been carried out to determine the level of organochlorine pesticides namely HCH, DDT and Endosulfan in raw fruit nuts. Nuts have proteins and high level of fat content. These properties of nuts attract organochlorine pesticides to accumulate. The analysis of organochlorine pesticide residues in commonly used dry fruits like Cashewnut, Walnut, Coconut, Chilgoza, Chironji, Makhana, Resins, Apricot, Almonds, Date palm, Pistachio nut collected from local market of Lucknow India has indicated presence of very low level of HCH (0.007-1.328 mg kg(-1)), DDT(ND-0.140 mg kg(-1)) and Endosulfan (ND-0.091 mg kg(-1)). There are no MRL values established for nuts in the country. This finding is based on a smaller number of samples, which however suggest that the presence of low level of DDT, HCH and Endosulfan might be due to environmental rather than direct exposure.

[J Environ Biol. 2010 Sep;31(5):705-7.]

Bioaccumulation of organochlorine pesticides in aquatic system.

In recent years, various environmental issues have aroused a concern on the pollution of pesticides in rivers and in their various intercompartments. Multiple residues of pesticides discharged from industries or as a result of extensive use of agrochemicals in agriculture have been monitored. These pesticide residues contaminate the river ecosystem and its intercompartments such as sediments, and aquatic biota, and make it harmful to humans when they contaminate food and drinking water. The pesticide contamination in water, sediments, and aquatic biota has been reported to be beyond the acceptable range. The most common found pesticides are organochlorine, namely, dichlorodiphenyltrichloroethane, hexachlorocyclohexane, endosulfan, heptachlor, lindane, dieldrin, aldrin, endrin, and others. The paper discusses the general description, classification, and toxicity of pesticides; it also aims to create public awareness among people and appraise them with various alternate methods to combat the problem of pesticide contamination. An attempt has also been made to elucidate the findings of various works on pesticides in aquatic system and to highlight the challenging aspects of pesticide contamination, which have not attracted the attention of investigators yet.



[Environ Monit Assess. 2011 Feb;173(1-4):905-16]

USGS Fact Sheet FS-170-96

Organochlorine pesticide residues in drinking water in the rural areas of Haryana, India.

Drinking water samples collected from rural areas of three districts of Haryana during pre-monsoon and post-monsoon periods were analysed for the presence of organochlorine pesticide residues. The main source of drinking water in rural areas, i.e. groundwater in Ambala and Gurgaon districts and surface water supply in Hisar district, was found to be contaminated with isomers of HCH and endosulfan and metabolites of DDT, whereas dieldrin remained below detection limits. During the study period, the mean values observed for total HCH, DDT and endosulfan were 87.6, 848.2, and 27.4Â ng/L and 99.8, 275.3 and 164.2Â ng/L, respectively, for Ambala and Gurgaon districts. In the case of Hisar district, the values were 78.5, 115.9, and 53.0Â ng/L, respectively. During the study period, 37% of the samples exceeded the total pesticide level of 500Â ng/L indicated in the EECD directive for drinking water. Seasonal variations of pesticide residues were also observed during the study period.

[Environ Monit Assess. 2011 Mar 17. (Epub ahead of print DOI: 10.1007/s10661-011-1950-9)]

Genotoxicity of the Ganges water at Narora (U.P.), India.

Water samples were collected from the river Ganga at Narora (U.P.). High performance liquid chromatography analysis of water samples by the liquid extraction procedure indicated the presence of several pesticides such as DDT, alpha-BHC, aldrin, endrin and dieldrin at concentrations of 1.36, 1.38, 0.95, 0.61 and 0.41 ppb, respectively. The organophosphorus pesticides such as dimethoate and methyl parathion also appear to be present at concentrations of 0.20 and 0.41 ppb, respectively. The XAD water concentrates and liquid-liquid extracted water samples were assayed for mutagenic potential by the Ames Salmonella/microsome test. The test samples exhibited a significant degree of mutagenicity with TA102, TA100 and TA98 strains both in the presence and absence of DNA repair defective mutants, recA, lexA and polA of E. coli was observed as compared to their wild-type counterpart in the presence of XAD water concentrates.

[Mutat Res. 1996 Apr 6;367(4):187-93.]

Î²-Hexachlorocyclohexane levels in serum and risk of Parkinson's disease.

Pesticide exposure has been implicated as an environmental risk factor for the development of Parkinson's disease (PD). However, few studies have identified specific pesticides. Previously, the authors identified elevated serum levels of the organochlorine pesticide Î²-hexachlorocyclohexane (Î²-HCH) in PD patients from a small clinical sample. Here, the authors conducted a case-control study to confirm the association between Î²-HCH and PD in a larger sample size (n=283) with serum samples of PD patients and controls obtained from UT Southwestern Medical Center and Emory University. Samples were obtained from two discrete periods at both sites, 2001-2003 and 2006-2008, and were analyzed for Î²-HCH levels. Adjusted odds ratios (ORs) for PD were estimated using logistic regression and generalized estimating equations. The mean serum Î²-HCH level across all cohorts in this study was 22.3ng/mg cholesterol (range: 0-376.7), and the levels were significantly higher between samples collected in 2001-2003 vs. 2006-2008. After controlling for age and gender, the OR for increased risk of PD for every 1ng/mg increase in serum Î²-HCH ranged from 1.02 to 1.12 across the four different cohorts, and 1.03 (95% CI: 1.00-1.07, p value=0.031) in the pooled analysis. Furthermore, the OR for increased risk of PD of subjects having serum Î²-HCH levels above the inter-quartile range of 39.08ng/mg cholesterol was 2.85 (95% CI: 1.8, 4.48; p value<0.001). These data are consistent with environmental decreases in Î²-HCH levels between 2001 and 2008, but they indicate that elevated levels of serum Î²-HCH are still associated with heightened risk for PD.

[Neurotoxicology. 2011 May 17. [Epub ahead of print doi:10.1016/j.neuro.2011.04.002]]

Endocrine disruptors as a threat to neurological function.

Endocrine disruption is a concept and principle whose origins can be traced to the beginnings of the environmental movement in the 1960s. It began with puzzlement about and the flaring of research on the decline of wildlife, particularly avian species. The proposed causes accented pesticides, especially persistent organochlorines such as DDT. Its scope gradually widened beyond pesticides, and, as endocrine disruption offered an explanation for the wildlife phenomena, it seemed to explain, as well, changes in fertility and disorders of male reproduction such as testicular cancer. Once disturbed gonadal hormone function became the most likely explanation, it provoked other questions. The most challenging arose because of how critical gonadal hormones are to brain function, especially as determinants of brain sexual differentiation. Pursuit of such connections has generated a robust literature embracing a broad swath of chemical classes. How endocrine disrupting chemicals influence the adult and aging brain is a question, so far mostly ignored because of the emphasis on early development that warrants vigorous investigation. Gonadal hormones are crucial to optimal brain function during maturity and even senescence. They are pivotal to the processes of neurogenesis. They exert protective actions against neurodegenerative disorders such as dementia and support smoothly functioning cognitive activities. The limited research conducted so far on endocrine disruptors, aging, and neurogenesis argues that they should be overlooked no longer.

[J Neurol Sci. 2011 April 7 [Epub ahead of print doi:10.1016/j.jns.2011.03.014.]]

Potential role for organochlorine pesticides in the prevalence of peripheral arterial diseases in obese persons: Results from the National Health and Nutrition Examination Survey 1999-2004.

The purpose of this study was to investigate the association between organochlorine (OC) pesticides and the prevalence of peripheral arterial disease (PAD). This study included 2032 participants from the National Health and Nutrition Examination Survey (1999-2004), in which the ankle brachial index (ABI) and serum levels of OC pesticides (p,p'-DDE, trans-nonachlor, oxychlordane, dieldrin, and Î²-HCH) were measured simultaneously. A diagnosis of PAD was determined on the basis of an ABI<0.9. The obesity status was categorized as obese group (BMI>25kg/m(2)) or non-obese group (BMI<25kg/m(2)). Compared with subjects without PAD, those with PAD had significantly higher lipid-standardized and wet-weight concentrations of OC pesticides. Obese subjects with PAD had significantly increased mean lipid-standardization value of p,p'-DDE (OR=1.47; 95% CI, 1.08-1.99), trans-nonachlor (OR=1.68; 95% CI, 1.10-2.56), oxychlordane (OR=1.82; 95% CI, 1.09-3.03), dieldrin (OR=2.36; 95% CI, 1.69-3.31), and sums of all five pesticides (OR=1.19; 95% CI, 1.07-1.33). For non-obese group, increases in the levels of OC pesticides and their sums did not account for increased risk ratio of PAD. OC pesticides are a potent risk factor for PAD. Additionally, obesity may modulate the association between OC pesticides and the development of PAD.

[Atherosclerosis. 2011 May 10. [Epub ahead of print doi:10.1016/j.atherosclerosis.2011.04.044]]

Maternal and cord blood levels of aldrin and dieldrin in Delhi population.

Aldrin and dieldrin, structurally similar organochlorine pesticides belong to cyclodiene family and were widely used for agriculture and public health program in India. Although the manufacturing, use and import of aldrin and dieldrin have been banned in India since 2003, these pesticides are still persistent in environment and may be associated with adverse neurological and reproductive effects. The aim of this study is to assess the recent exposure level of aldrin and dieldrin and their placental transfer to fetus in normal healthy full-term pregnant women belonging to north Indian population undergoing normal delivery at Obstetrics and Gynecology department of UCMS and GTB hospital, Delhi. Quantitative analysis of aldrin and dieldrin residues in maternal and cord blood samples were carried out by gas chromatography system equipped with electron capture detector. The results of our study clearly revealed that maternal and cord blood levels of aldrin and dieldrin of pregnant women are age and dietary habit dependent. The aldrin level in maternal blood and dieldrin level in cord blood are higher in women in the age group 25-30 years than in women in age group of 19-24 years. Similarly, aldrin level in maternal blood is significantly higher in women with non-vegetarian dietary habit than in women with vegetarian dietary habit. No significant association is found for maternal and cord blood level. The results of the present study clearly demonstrate prenatal uptake of aldrin and dieldrin and provide recent information on the subsequent transplacental transfer.

[Environ Monit Assess. 2010 Dec;171(1-4):633-8]

Persistent organochlorines in human breast milk from major metropolitan cities in India.

The present study was carried out to understand the current contamination status of organochlorine compounds (OCs) in human breast milk from three metropolitan cities in India (New Delhi, Mumbai and Kolkata). Among the OCs analyzed, DDTs were predominant followed by HCHs and PCBs. CHLs and HCB levels were much lower. Contamination patterns were different in human milk found in our previous study in Chennai, a metropolitan city in southern India, indicating region specific exposure routes and variable sources. In comparison with previous data, levels of DDTs and HCHs generally declined with time, implying the effect of various bans and restrictions on their usage. No association between concentrations of OCs and demographic characteristics such as parity and age of mothers was observed which might be due to narrow range of mother's age. Estimated daily intake shows that some infants are exposed to OCs to a greater extent, particularly HCHs than the guideline standard.

Environ Pollut. 2009 Jan;157(1):148-54.

Susceptibility of epigeic earthworm *Eisenia fetida* to agricultural application of six insecticides.

Ecotoxicological risks of agricultural application of six insecticides to soil organisms were evaluated by acute toxicity tests under laboratory condition following OECD guidelines using the epigeic earthworm *Eisenia fetida* as the test organism. The organochlorine insecticide endosulfan (LC(50) - 0.002mgkg(-1)) and the carbamate insecticides aldicarb (LC(50) - 9.42mgkg(-1)) and carbaryl (LC(50) - 14.81mgkg(-1)) were found ecologically most dangerous because LC(50) values of these insecticides were lower than the respective recommended agricultural dose (RAD). Although *E. fetida* was found highly susceptible to the pyrethroids insecticide cypermethrin (LC(50) - 0.054mgkg(-1)), the value was higher than its RAD. The organophosphate insecticides chlorpyrifos (LC(50) - 28.58mgkg(-1)), and monocrotophos (LC(50) - 39.75mgkg(-1)) were found less toxic and ecologically safe because the LC(50) values were

much higher than their respective RAD.

[Chemosphere. 2011April 12 [Epub ahead of print doi:10.1016/j.chemosphere.2011.03.016]]

Occurrence of organochlorine pesticides in indoor dust.

Organochlorine pesticides are present in the environment and suspected of causing serious health effects. Diet has been the main exposure source, but indoor source release is gaining focus. Within a monitoring study of polychlorinated biphenyls of Danish buildings built during the 1960s and 1970s, The authors coincidently determined extreme levels of dichlorodiphenyltrichloroethane (DDT) levels in two of ten random samples. This raises concern and further large scale investigations are warranted to confirm this.

[J Environ Monit. 2011 Mar;13 (3):522-6.]

Assessment of nonoccupational exposure to DDT in the tropics and the north: relevance of uptake via inhalation from indoor residual spraying.

People who live in dwellings treated with indoor residual spraying (IRS) of DDT [1,1,1-trichloro-2,2-bis(p-chlorophenyl)ethane] for disease-vector control in the tropics and indigenous populations in the Arctic who consume marine mammals experience high nonoccupational exposure to DDT. Although the use of DDT in IRS is rising, the resulting nonoccupational exposure is poorly characterized. The authors have provided a comparative assessment of exposure to DDT and its metabolites in the general population of the tropical and northern regions and in highly exposed populations in these regions. The authors compiled > 600 average or median DDT concentrations from the peer-reviewed literature, representing > 23,000 individual measurements in humans, food, air, soil, and dust. The authors use Monte Carlo sampling of distributions based on these data to estimate distributions of population- and route-specific uptake. The authors evaluate their exposure estimates by comparing them with biomonitoring data. DDT concentrations are highest in people living in IRS-treated houses and lowest in the northern general population, differing by a factor of about 60. Inuits and the general population in the tropics have similar concentrations. Inhalation exposure explains most of the difference in concentration between the highly exposed and the general population in the Tropics. Calculated exposure levels are consistent with human biomonitoring data. Nonoccupational inhalation exposure is a relevant exposure pathway for people living in homes treated by IRS of DDT. Continued monitoring of time trends and DDE to DDT ratios in the Tropics and in the North is needed to identify a possible slowdown in concentration decline and the influence of ongoing DDT use.

[Environ Health Perspect. 2011 May;119(5):707-12.]

Global status of DDT and its alternatives for use in vector control to prevent disease.

In this article the status of dichlorodiphenyltrichloroethane (DDT), used for disease vector control, and its benefits and risks in relation to the available alternatives was reviewed. Contemporary data on DDT use were obtained from questionnaires and reports as well as a Scopus search to retrieve published articles. Nearly 14 countries use DDT for disease control, and several others are reintroducing DDT. Concerns about the continued use of DDT are fueled by recent reports of high levels of human exposure associated with indoor spraying amid accumulating evidence on chronic health effects. There are signs that more malaria vectors are becoming resistant to the toxic action of DDT. Effective chemical methods are available as immediate alternatives to DDT, but the development of resistance is undermining the efficacy of insecticidal tools. Nonchemical methods are potentially important, but their effectiveness at program level needs urgent study. To reduce reliance on DDT, support is needed for integrated and multipartner strategies of vector control. Integrated vector management provides a framework for developing and implementing effective technologies and strategies as sustainable alternatives to reliance on DDT.

[Cien Saude Colet. 2011 Feb;16(2):575-90. Republished from Environ Health Perspect. 2009 Nov;117(11):1656-63.]

Remediation of lindane using engineered nanoparticles.

Organochlorine pesticides (OCPs; aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex, toxaphene and hexachlorocyclohexane) are chemical pollutants found in all environmental media. There is an urgent need to stop the usage and develop innovative strategies for the remediation of contaminated soil and water. The present work was aimed to evaluate the (i) interaction of fullerene with lindane and its role in the remediation of lindane from contaminated systems and (ii) compare the interaction of fullerene with lindane and trichloroethylene. Strong molecule-surface bonding of fullerene-lindane complex than fullerene-TCE complex indicates that fullerene can be used as a potential nanoparticle for remediation of lindane. However, toxicity and fate of nanoparticles is under investigation and more studies are needed before utilization of fullerene and other nanoparticles for phytoremediation.

[J Biomed Nanotechnol. 2011 Feb;7(1):172-4.]

Degradation of lindane contaminated soil using zero-valent iron nanoparticles.

Lindane, has been classified by the United States Environment Protection Agency as a potent carcinogen and teratogen. Zero-valent iron nanoparticles (nZVI) have

been shown to effectively transform chlorinated hydrocarbons, organochlorine pesticides. An attempt has been made to explore the potential of nZVI for the remediation of Lindane contaminated soil. nZVI was synthesized by reducing $FeCl_3$ with $NaBH_4$. Lindane (10 microg/g) completely disappeared from spiked soil within 24 hours at nZVI concentration of 1.6 g/L, indicating its possible use in environmental cleanup. Reductive dehalogenation is the predominant mechanism for the removal of Lindane from spiked soil by nZVI. Dechlorination was further confirmed by the chloride ion release.

[J Biomed Nanotechnol. 2011 Feb;7(1):175-6.]

Bioremediation of single and mixture of pesticide-contaminated soils by mixed pesticide-enriched cultures.

In the present study, degradation efficiencies for individual as well as mixed pesticide in different Indian soils, by mixed pesticide-enriched cultures, were evaluated under submerged and unsaturated conditions, Lindane (L), methyl parathion (MP), carbofuran (C), and a mixture of L, MP, and C were used in the study. For all the various conditions considered, methyl parathion degradation was the maximum and lindane degradation was the minimum. The degradation kinetics of the pesticides in sandy, clayey, compost, and red soils by various microbial isolates were studied. It was observed that adsorption was maximum and degradation of pesticides was minimum in compost soil. The degradation efficiencies of pesticides in liquid phase associated with soil sediment were less than those under the normal liquid phase conditions as leaching of pesticides from soil phase was continuous. Pesticide degradation was more in submerged soils compared to that in unsaturated soils. The degradation by-products of individual and mixed pesticides in liquid, unsaturated, and submerged soils were identified. Different metabolites were produced under submerged and unsaturated conditions.

[Appl Biochem Biotechnol. 2011 March 19[Epub ahead of print DOI: 10.1007/s12010-011-9211-5]

Three-year atmospheric monitoring of organochlorine pesticides and polychlorinated biphenyls in polar regions and the South Pacific.

XAD-2 resin based passive air samplers (PAS) were deployed for three one-year periods at the Korean polar and South Pacific research stations at Ny-Ålesund (2005-2009), King George Island (2005-2007), and Chuuk (2006-2009) to investigate long-range transport, local sources, and temporal trends of organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs). The highest hexachlocyclohexane (HCH) concentration (35.2-78.9 pg·m(-3)) over the entire sampling period was detected at Ny-Ålesund, in the Arctic. α-HCH was the dominant OCP (31.1-67.1 pg·m(-3)), contributing about 50% of the total OCP load. Additionally, a high and consistent α/γ-HCH ratio was observed at Ny-Ålesund. HCHs might reach Arctic sites more easily than other OCPs from surrounding countries through long-range atmospheric transport (LRAT). Interestingly, high levels of the current-use OCP endosulfan-particularly endosulfan-I--were detected at almost all sampling sites, including in Antarctica, ranging 12.2-88.5, 17.7-130, and ND-59.7 pg·m(-3) at King George Island, Ny-Ålesund, and Chuuk, respectively. Specific OCP and PCB patterns, such as low trans/cis-chlordane ratios and a prevalence of lighter PCB congeners, were observed in all three regions (excepting one site at Ny-Ålesund and one site in the South Pacific affected by local sources) during all sampling periods. This indicates that these Polar and remote South Pacific sites are mainly influenced by LRAT. Over the entire sampling period, a decreasing trend of HCHs (α- and γ-HCH) and an increasing trend of endosulfan-I were observed at the Ny-Ålesund sites.

[Environ Sci Technol. 2011 May 15;45(10):4475-82.]

Levels of persistent organic pollutant and their predictors among young adults.

Exposure to persistent organic pollutants (POPs), such as polychlorinated biphenyls (PCBs), dichlorodiphenyldichloroethane (p,p'-DDE), and hexachlorobenzene (HCB) continues to be of concern due to their ubiquitous distribution and high persistence. Current toxicant body burden is still a primary concern within the Akwesasne Mohawk Nation since other studies conducted within the community have shown relationships between these POPs and endocrine disruption. In this article authors describe the levels of these toxicants in young adults of the Akwesasne Mohawk Nation between the ages of 17 and 21 years of age (mean age 18.1 years), and investigate potential influences of their current body burden. Seventeen congeners in fourteen chromatographic peaks were detected in 50% or more of the individuals sampled (geometric mean [GM] of the sum of these congeners=0.43 ppb). Congeners 118, 138[+163+164] and 153 had the highest rate of detection (≥98%) within the Akwesasne young adults. Of the other organochlorines, HCB (GM=0.04 ppb) and p,p'-DDE (GM=0.38 ppb) were found in 100% and 99% of the sample respectively. Significantly higher levels of PCBs were found among individuals who were breastfed as infants, were first born, or had consumed local fish within the past year. When compared to levels of p,p'-DDE, HCB, and 13 specific congeners reported by the CDC for youth between the ages of 12 and 19 years, the geometric means of several congeners (CBs 99, 105, 110, and 118) among the Akwesasne were higher than the reported CDC 90th percentile. In contrast, levels of CB 28 in Akwesasne young adults were ~50% or less than those of the CDC cohort. p,p'-DDE and HCB levels were generally higher in the CDC cohort (GM of 0.516 and 0.065 ppb, respectively for Mohawks vs. 2.51 and 0.123, respectively, for CDC). Concentrations of non-persistent PCBs among this sample of Akwesasne young adults were higher

than those reported by the CDC suggesting continued exposure, but lower than those associated with severe contamination. Additional research into the concentration trends of individual PCB congeners within Akwesasne youth and young adults is warranted to further improve the insight into the determinants and influences of organochlorine concentrations within members of the Akwesasne community.

[Chemosphere. 2011 May; 83(10):1374-82.]

Polychlorinated biphenyls and organochlorine pesticides in local waterbird eggs from Hong Kong: risk assessment to local waterbirds.

The contamination status of the marine environment in Hong Kong was studied by measuring concentrations of organochlorine (OC) pollutants (i.e., hexachlorobenzene, aldrin, dieldrin, endrin, mirex, total heptachlor, total chlordane, total DDTs, total PCBs, and total toxaphenes) in the eggs of selected waterbird species from different locations around the city: Little Egret (*Egretta garzetta*) and Chinese Pond Heron (*Ardeola bacchus*) from Mai Po Village, Great Egret (*Ardea alba*) and Black-crowned Night Heron (*Nycticorax nycticorax*) from A Chau, and Chinese Pond Heron (*A. bacchus*) from Ho Sheung Heung. The mean concentrations of total PCBs and total DDTs ranged from 191-11,100 ng g(-1) lipid and 453-49,000 ng g(-1) lipid, respectively. Recent exposure of waterbirds to technical chlordane was found in Hong Kong. The risk characterization demonstrated potential risks to birds associated with exposure to DDE, which was found to cause a reduction in survival of young in Hong Kong Ardeids based on the endpoint in the risk assessment.

[Chemosphere.2011May;83(7):891-6.]

Relationship between occupational social class and exposure to organochlorine pesticides during pregnancy.

Little evidence is available on the influence of socioeconomic factors on exposure to persistent organic pollutants, especially during vulnerable periods such as pregnancy and early life. To investigate the relationship of maternal social class with placental concentrations of organochlorine pesticides (OCPs) and their combined estrogenic activity measured with a biomarker of exposure. Exposure to 16 OCPs (DDTs, endosulfans, and seven other compounds) and the total effective xenoestrogenic burden (TEXB) were analyzed in placentas from a mother-child cohort. OCP concentrations were quantified by gas chromatography and mass spectrometry, and TEXB was assessed with the E-Screen bioassay. Social class was classified according to maternal occupation. Multivariate regression analysis was conducted to examine variations in pesticide exposure and TEXB as a function of maternal social class in 257 subjects. Placental p,p'-DDT concentrations were higher in social classes III and IV than in classes I-II (the most affluent); concentrations of the sum of DDTs were higher in class IV; and exposure to the sum of endosulfans was greater in class III. HCB concentrations were higher among women in class IV than in classes I-II and among manual (classes III-V) than non-manual workers. However, the trend across social classes was only statistically significant for HCB. Social class significantly explained 10% of the variability in concentrations of the sum of endosulfans.: There is a need to explore whether more disadvantaged populations suffer higher levels of exposure to pesticides or other environmental chemicals and how different social processes contribute to this exposure.

[Chemosphere.2011Apr;83(6):831-8.]

Persistent organic pollutants in Mediterranean seawater and processes affecting their accumulation in plankton.

The Mediterranean and Black Seas are unique marine environments subject to important anthropogenic pressures due to riverine and atmospheric inputs of organic pollutants. The authors report the results obtained during two east-west sampling cruises in June 2006 and May 2007 from Barcelona to Istanbul and Alexandria, respectively, where water and plankton samples were collected simultaneously. Both matrixes were analyzed for hexaclorochyclohexanes (HCHs), hexachlorobenzene (HCB), and 41 polychlorinated biphenyl (PCB) congeners. The comparison of the measured HCB and HCHs concentrations with previously reported dissolved phase concentrations suggests a temporal decline in their concentrations since the 1990s. On the contrary, PCB seawater concentrations did not exhibit such a decline, but show a significant spatial variability in dissolved concentrations with lower levels in the open Western and South Eastern Mediterranean, and higher concentrations in the Black, Marmara, and Aegean Seas and Sicilian Strait. PCB and OCPs (organochlorine pesticides) concentrations in plankton were higher at lower plankton biomass, but the intensity of this trend depended on the compound hydrophobicity (K(OW)). For the more persistent PCBs and HCB, the observed dependence of POP concentrations in plankton versus biomass can be explained by interactions between air-water exchange, particle settling, and/or bioaccumulation processes, whereas degradation processes occurring in the photic zone drive the trends shown by the more labile HCHs. The results presented here provide clear evidence of the important physical and biogeochemical controls on POP occurrence in the marine environment.

[Environ Sci Technol. 2011 May 15;45(10):4315-22]

Studies on urban drinking water quality in a tropical zone.

Anthropogenic activities associated with industrialization, agriculture and urbanization have led to the deterioration in water quality due to various contaminants. To assess the status of urban drinking water quality,

samples were collected from the piped supplies as well as groundwater sources from different localities of residential, commercial and industrial areas of Lucknow City in a tropical zone of India during pre-monsoon for estimation of coliform and faecal coliform bacteria, organochlorine pesticides (OCPs) and heavy metals. Bacterial contamination was found to be more in the samples from commercial areas than residential and industrial areas. OCPs like α,γ-hexachlorocyclohexane and 1,1 p,p-DDE {dichloro-2, 2-bis(p-chlorophenyl) ethene)}were found to be present in most of the samples from study area. The total organochlorine pesticide levels were found to be within the European Union limit (0.5 µg/L) in most of the samples. Most of the heavy metals estimated in the samples were also found to be within the permissible limits as prescribed by World Health Organization for drinking water. Thus, these observations show that contamination of drinking water in urban areas may be mainly due to municipal, industrial and agricultural activities along with improper disposal of solid waste. This is an alarm to safety of public health and aquatic environment in tropics.

[Environ Monit Assess. 2011 Mar 17. (Epub ahead of print doi:10.1007/s10661-011-1980-3)]

Intra uterine growth retardation: association with organochlorine pesticide residue levels and oxidative stress markers.

Intra uterine growth retardation (IUGR) is a major complication of pregnancy, affecting 5% to 10% of newborns. Hexachlorocyclohexane (HCH) is an organochlorine pesticide that consists of eight stereoisomers and γ-isomer is the only isomer that possesses insecticidal activity. The aim of the present study was to analyze the OCP residues in maternal and cord blood of women and to assess the level of oxidative stress markers as well as to establish correlation with OCP levels. Fifty women delivering neonates with low birth weight (IUGR) and equal number of women delivering normal birth weight babies (control) were recruited. Authors have observed higher levels of γ-HCH and T-HCH and increased oxidative stress markers in IUGR subjects versus control subjects. Significant correlations were also found between HCH isomers and oxidative stress markers in IUGR subjects. In conclusion, Results suggest that higher levels of HCH isomers may be associated with IUGR and increased oxidative stress.

[Reprod Toxicol. 2011 May;31(4):534-9.]

Organochlorine pesticide gradient levels among maternal adipose tissue, maternal blood serum and umbilical blood serum.

The objective of the present study was to determine levels and calculate ratios of copartition coefficients among organochlorine pesticides β-HCH, pp'DDE, op'DDT and pp'DDT in maternal adipose tissue, maternal blood serum and umbilical blood serum of mother-infant pairs from Veracruz, Mexico. Organochlorine pesticides were analyzed in 70 binomials: maternal adipose tissue, maternal serum and umbilical cord serum samples, using gas chromatography with electron capture detection (GC-ECD). The results were expressed as mg/kg on fat basis. p,p'-DDE was the major organochlorine component, detected in every maternal adipose tissue (0.770 mg/kg), maternal serum sample (5.8 mg/kg on fat basis) and umbilical cord blood sample (6.9 mg/kg on fat basis). p,p'-DDT was detected at 0.101 mg/kg, 2.2 mg/kg and 5.9 mg/kg respectively, according to the order given above. β-HCH was detected at 0.027 mg/kg, 4.2 mg/kg and 28.0 mg/kg respectively. op'DDT was detected only in maternal adipose tissue at 0.011 mg/kg. The copartition coefficients among samples identify significant increases in concentrations from adipose tissue to maternal blood serum and to umbilical blood serum. The increase indicated that maternal adipose tissue released organochlorine pesticides to blood serum and that they are carried over to umbilical cord blood.

[Bull Environ Contam Toxicol. 2011 Mar;86(3):289-93.]

Increased risk of non-Hodgkin lymphoma and serum organochlorine concentrations among neighbors of a municipal solid waste incinerator.

Organochlorine chemicals may contribute to an increased risk of non-Hodgkin lymphoma (NHL) within non-occupationally exposed populations. Among these chemicals, dioxins and furans were mainly released by municipal solid waste incinerators (MSWIs) until a recent past in France, a source of exposure that is of public concern. We investigated organochlorines and the risk of NHL among neighbors of a French MSWI with high levels of dioxin emissions (Besançon, France), using serum concentrations to assess exposure. The study area consisted of three electoral wards, containing or surrounding the MSWI. Pesticides, dioxins, furans, and polychlorinated biphenyls (PCBs) were measured in the serum of 34 newly diagnosed NHL cases (2003-2005) and 34 controls. Risks of NHL associated with each lipid-corrected serum concentration were estimated using exact logistic regression. The pesticides β-hexachlorocyclohexane (odds ratio [OR]=1.05, 95% confidence interval [CI]=1.00-1.12, per 10 ng/g lipid) and p,p' dichloro-diphenyl-trichloroethane (DDT) (OR=1.20, 95% CI=1.01-1.45, per 10 ng/g lipid) were associated with NHL risk. Evidence indicated an increased NHL risk associated with cumulative WHO(1998)-toxic equivalency factor (TEQ) concentrations (dioxins, OR=1.12, 95% CI=1.03-1.26; furans, OR=1.16, 95% CI=1.03-1.35; dioxin-like PCBs, OR=1.04, 95% CI=1.00-1.07; and total TEQ, OR=1.04, 95% CI=1.01-1.05), as well as with non dioxin-like PCBs (OR=1.02, 95% CI=1.01-1.05, per 10 ng/g lipid). Most congener-specific associations were statistically significant. This study provides strong and consistent support for an association between serum cumulative WHO(1998)-TEQ concentrations, at levels experienced by people residing in the vicinity of a polluting MSWI, and risk of NHL.

[Environ Int. 2011 Feb;37(2):449-53.]

DID YOU KNOW ?

- It is estimated that 1ppb DDT in serum means 5-10 ppb in brain, 47 ppb in liver, 100-300 ppb in fat cell. Residues are present in fat tissues and released during stress, rigorous exercise or weight loss as a result of lipolysis, hence serum level of toxins are due to recirculation of toxins released from adipose tissue.
- Once a house has been treated with chlordane, it can be found in dust for the life of the house.
- Leafy vegetables contain more DDT.

CURRENT CONCERNS

- Nearly 14 countries use DDT for vector control, and several others are reintroducing DDT. Concerns about the continued use of DDT are raised by reports of human exposure associated with indoor spraying and evidences on their chronic health effects. It has been observed that malaria vectors are becoming resistant to the toxic action of DDT.
- Organochlorine pesticides are reported as endocrine disrupting chemicals, ie they can adversely affect the body's hormonal systems. Endocrine disrupting chemicals often mimic the body's natural hormones, disrupting normal functions and contributing to adverse health effects.
- Organochlorine pesticide exposure is associated with neurodevelopmental health effects in humans. Exposure to organochlorine pesticides has been linked to decreased psychomotor function and mental function, including memory, attention, and verbal skills in children.
- Chlorinated pesticide are lipophilic in nature, they bioaccumulate in adipose tissue in the body. These fat soluble compounds pass from mother to child and they are difficult to excrete from the body.
- **Endosulfan Controversy**: Endosulfan is commonly used as pesticide and is very cheap (only about Rs. 300/kg as compared to other pesticide) as compared to its other substitutes in the market. India was not in favour of banning the chemical, because of its low price. Various NGOs and health authorities claim that the chemical has caused several deaths in human beings, urging for a ban. The pesticide can cause health complications and affect the environment, they claim. The meeting of the parties of the Stockholm Convention which met in Geneva decided to put a conditional ban on the endosulphan globally. India which is a major producer and exporter of the pesticide had strongly opposed the ban. At last India had to agree to the majority opinion of ban, Countries including India will be allowed a time period of 11 years to completely ban the pesticide. However, the present decision to ban is only

the primary step. Each country should submit a list of agricultural products which need endosulphan. As the pesticide is now banned, each country should report to the Stockholm Convention regarding the stock of the pesticide in the country. However, the global ban may not bring great gains to Kerala, where the dangerous pesticide is already banned. What remains to be done here is the proper rehabilitation of the victims, and the blocking of the continuing flow of the endosulphan into the state. The dangerous pesticide endosulphan was used in the cashew plantations of Kasargod in north Kerala to more than a decade. The pesticide was sprayed aerially in the plantation from 1978 to 2001, which resulted in serious after-effects including environmental and health hazards. The victims of the endosulphan have since been in the path of struggle, not only try to erase the bad marks the pesticide had sealed on their lives, but also to bring to light the harmful effects of the poisonous chemical. Social activists, environmental and human rights groups, etc joined their struggle to create awareness about the chemical. The struggle of the people of some villages in Kasargod gradually became the struggle of whole Kerala and now, the voice of the world.

ENDOSULFAN COST COMPARISON

Product	MRP Rs. per litre or kg
Endosulfan	786
Flubendiamide	13800
Chlorantraniliprole	12280
Emamectin Benzoate	8400
Flubendiamide	7434
Thiomethoxain	1010
Indoxacarb	3400
Imidacloprid	2229

Source : Speciality chemicals Magzine April 2011

REGULATORY TRENDS

In India **Central Insecticides Board** (Established Under Section 4 of the Insecticides Act, 1968) is responsible for all the regulations of insecticides with the following objectives and functions

1. The Central Insecticides Board advises the Central Government and State Governments on technical matters arising out of the administration of this Act and to carry out the other functions assigned to the Board by or under this Act.
2. The matters on which the Board may advise includes :

a. the risk to human being or animals involved in the use of insecticides and the safety measures necessary to prevent such risk ;

b. the manufacture, sale, storage, transport and distribution of insecticides with a view to ensure safety to human beings or animals.

c. Advise the Central Government on the manufacture of insecticides under the Industries (Development and Regulation) Act, 1951 (65 of 1951).

d. Specify the uses of the classification of insecticides on the basis of their toxicity as well as their being suitable for aerial application.

e. Advise tolerance limits for insecticides residues and establishment of minimum intervals between the application of insecticides and harvest in respect of various commodities.

f. Specify the shelf-life of insecticides.

g. Suggest colourisation, including colouring matter which may be mixed with concentrates of insecticides, particularly those of highly toxic nature.

h. Carry out such other functions as are supplemental, incidental or consequential to any of the functions conferred by the Act or the Rules.

ON THE LIGHTER SIDE

- Organic chemistry is the chemistry of carbon compounds. Biochemistry is the study of carbon compounds that crawl. -- Mike Adams.
- A bunch of American researchers produced the thinnest wire the world had ever seen. They decided to go round the world to show off their invention. First they went to the Japanese, who promptly bore a hole through the wire. Determined to avenge this Asian humiliation, they went to India. Where a Sardar working in his backyard wrote in microscopic letters on it ``Made in India

ON THE WEB

http://www.cdc.gov/exposurereport/data_tables/chemical_group_0802.html Provides information about organochlorine pesticides.

http://organic.about.com/od/organicdefinitionsop/g/Organochlorine-Pesticides-Definition-Of-Organochlorine-Pesticides.htm

http://www.ewg.org/chemindex/research/447 Describes Organochlorine Pesticides (OCs): Related Research

http://www.environment.gov.au/settlements/publications/chemicals/scheduled-waste/ocpfactsheet5/tradenames-ab.html Lists Organochlorine Pesticides (OCPs) Trade or Common Use Names

CONFERENCES

October 8-12, 2012 Beijing China 4th International Symposium on Pesticide and Environmental Safety & 8th International Workshop on Crop Protection Chemistry and Regulatory Harmonization

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August 24-28, 2014 San Francisco - U.S.A. CA(U.S.A.) 13th International Congress on Pesticide Chemistry

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BOOK STOP

Title **Persistent Organic Pollutants**

Author Stuart Harrad

Editor Stuart Harrad

Publisher John Wiley and Sons, 2010

ISBN 1405169303, 9781405169301

Length 288 pages

Persistent organic pollutants (POPs) are organic compounds that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife. The Stockholm Convention on POPs is a global treaty to protect human health and the environment from POPs which came into force in 2004. Currently, twelve substances or substance groups are included under the Stockholm Convention, but there is a case for including new and emerging POPs such as brominated flame retardants and perfluorinated substances. This book considers these two new pollutants, together with the emerging area of chirality and its applications as an environmental forensics tool, and the topic of POPs contamination of indoor environments.

Title **Persistent Pollution â Past, Present and Future: School of Environmental Research -Organized by Helmholtz Centre Geesthacht**

Editors Markus Quante, Ralf Ebinghaus, Götz Flöser, G Tz Fl Ser

Publisher Springer, 2011

ISBN 3642174205, 9783642174209

Length 499 pages

This book evolved from the 5th School of Environmental Research entitled Persistent Pollution Past, Present and Future, which has set a focus on Persistent Organic Pollutants (POPs), heavy metals and aerosols. Research topics covered by the School included the reconstruction of past changes based on the scientific analysis of natural archives such as ice cores and peat deposits, evaluation of the present environmental state by the integration of measurements and modelling and the establishment of cause-effect-patterns, assessment of possible environmental future scenarios including emission and climate change perspectives. Leading scientists in the field of Marine and Atmospheric Chemistry, Meteorology and Modelling, Environmental Chemistry and Physics, as well as Environmental Policy and Management have prepared manuscripts. The book consists of 19 contributions prepared by more than 40 authors. The structure of the book has been outlined according to the topics addressed by the School and includes synthesis chapters which look into the history and reconstruction of environmental pollution, address emission questions, provide a closer look on selected persistent pollutants, deal with transport and modelling aspects, shed light on some health issues related to persistent pollutants, and discuss emerging contaminants in the atmospheric and marine environment.

Title **Organic Xenobiotics and Plants: From Mode of Action to Ecophysiology**

Volume 8 of Plant Ecophysiology

Author Peter Schröder

Editors Peter Schröder, Christopher D. Collins

Publisher Springer, 2010

ISBN 9048198518, 9789048198511

Length 311 pages

Natural and agro-ecosystems are frequently exposed to natural or synthetic substances, which, while they have no direct nutritional value or significance in metabolism, may negatively affect plant functioning. These, xenobiotics, may originate from both natural (fires, volcano eruptions, soil or rock erosion, biodegradation) and anthropogenic (air and soil pollution, herbicides) sources. And, while affected plants have only a limited number of possibilities for avoiding accumulation of these compounds, they do exhibit several enzymatic reactions for detoxification including oxidation, reduction, hydrolysis and conjugation reactions. In agro-ecosystems in particular these mechanisms have great significance in relation to herbicide detoxification and tolerance. In this volume an international group of experts present an overview of the nature and distribution of organic xenobiotics, including their uptake, effects on plant functioning and detoxification mechanisms. The particular significance of glutathione S-

transferases in bio-indication and bio-monitoring, and in the detoxification of volatile organic air pollutants and herbicides is evaluated, and their potential significance in phytoremediation and bioaccumulation will be discussed. This volume will be of interest to a wide audience, from graduate students to senior researchers in a wide range of disciplines including plant ecology, plant biochemistry, agriculture and environmental management. It will also be of practical interest to environmentalists, policy makers and resource managers.

Title	**Toxicological Profile for DDT/DDD/DDE (Update)**
Author	Obaid Faroon
Publisher	DIANE Publishing, 2010
ISBN	1437930670, 9781437930672
Length	476 pages

DDT is a pesticide that was once widely used to control insects. Both DDD and DDE are breakdown products of DDT. This profile includes: (1) the examination, summary, and interpretation of available toxicological information and epidemiologic evaluations on DDT/DDD/DDE to ascertain the levels of significant human exposure for the substance and the associated chronic health effects; (2) a determination of whether adequate information on the health effects of DDT/DDD/DDE is available to determine levels of exposure that present a significant risk to human health of chronic health effects; and (3) identification of toxicological testing needed to identify the types or levels of exposure that may present significant risk of adverse health effects in humans.

MINIPROFILE OF DICHLORO DIPHENYL TRICHLOROETHANE (DDT)

CHEMICALNAME: DICHLORO DIPHENYL TRICHLOROETHANE (DDT)

SYNONYM:

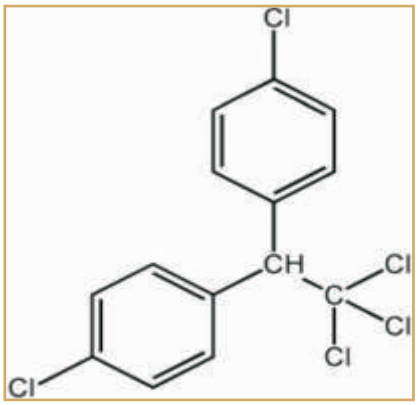
dichlorodiphenyltrichloroethane; chlorophenothane; p,p'-dichlorodiphenyltrichloroethane; 1,1,1-trichloro-2,2-di(4-chlorophenyl)ethane; anofex; dicophane; didigam; didimac; estonate; genitox; gesafid; gesarol; gyron; ixodex; nci-c00464; neocid; pentachlorin; santobane; trichlorobis(4-chlorophenyl)ethane; zeidane; zerdane; agritan; arkotine; azotox; bosan; supra; boviderm; chlorphenothan; chlorophenotoxum; citox; clofenotane; dedlo; deoval; detox; detoxan; dibovan; dodat; dykol; gesafid; gesapon; gesarex; guesapon; havero-extra; hildit; ivoran; kopsol; mutoxin; parachlorocium; pentech; ppzeidan.

RTECS NO: KJ 3325000

CAS NO: 50-29-3

MOLECULAR FORMULA: $C_{14}H_9Cl_5$

MOLECULAR WEIGHT: 354.5



PROPERTIES: Colour- Colorless crystals or off-white powder; Odour- Odourless or with slight aromatic odor; Solubility- It is nearly insoluble in water but has a good solubility in most organic solvents, fats, and oils; BP 416.2 °C at 760 mmHg; MP 109 °C; FlashPoint 203.9 °C; Density 1.451 g/cm3; VP 9.42 E-07 mmHg at 25°C

USES: DDT is a synthetic chemical compound once used widely in the United States and throughout the world as a pesticide. It is used to prevent growth of mosquitoes and reduce incidences of malaris in Africa (1 & 2). DDT (dichlorodiphenyltrichloroethane) is an insecticide (for disease vector control) reportedly induces cancer in animals, mimics estrogen activity, induces antiandrogen effects, and impairs Natural Killer (NK) cells and T lymphocyte responses.

STORAGE AND DISPOSAL: Should not be kept in iron containers and should not be mixed with iron and aluminum salts nor with alkaline substances. High storage temperatures should also be avoided. DDT is a potential candidate for incineration by rotary kiln with a temperature range of 820 to 1600 deg C and residence time of seconds for liquids and gases, and hours for solids

TOXICITY DATA

LD_{50} Mouse oral 150-300 mg/kg

LD_{50} Dog oral 500-750 mg/kg

LD_{50} Sheep oral >1000 mg/kg

LD_{50} Goat oral >1000 mg/kg

LD_{50} Rat oral 100 mg/kg

LD_{50} Rabbit oral 300 mg/kg

ROUTE	SYMPTOMS	FIRST AID	TARGET ORGAN
Inhalation & Ingestion	Cough, diarrhoea, dizziness, headache, vomiting, numbness, shortness of breath, or burning in the mouth, throat, or chest, paresthesias, hyper excitability and convulsions. Symptoms also include tingling of lips, tongue, face, malaise, headache, sore throat.	Take deep breaths of fresh air, provide proper respiratory protection to rescuers entering an unknown atmosphere. In case the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and immediately call a hospital or poison control center. Generally, the induction of vomiting is NOT recommended outside of a physician's care due to the risk of aspirating the chemical into the victim's lungs. However, if the victim is conscious and not convulsing and if medical help is not readily available, consider the risk of inducing vomiting because of the high toxicity of the chemical ingested. Ipecac syrup or salt water may be used in such an emergency. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. Do not induce vomiting.	Central Nervous System, Digestive System, Brain, Reproductive system, Heart, Blood vessels, Kidneys and Endocrine system.
contact	Coarse tremors of eyelids	First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication	Skin and Eyes

MAY WE HELP YOU

To keep abreast with the effects of chemicals on environment and health, the ENVIS Centre of
Indian Institute of Toxicology Research, deals with:

Maintenance of toxicology information database on chemicals

Information collection, collation and dissemination

Toxic chemical related query response service

Preparation of monograph on specified chemicals of current concern

Publishing Abstract of Current Literature in Toxicology

for further details do write to

Scientist In-Charge

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