

ORGANOCHLORINE POISONING



The great expectations held for DDT have been realized. During 1946, exhaustive scientific tests have shown that, when properly used, DDT kills a host of destructive insect pests, and is a benefactor of all humanity.

one of the country's largest producers of this amazing insecticide. Today, everyone can enjoy added comfort, health and safety through the insect-killing powers of Pennsalt DDT products . . . and DDT is only one of Pennsalt's many chemical products which benefit industry, farm and home.

Pennsalt produces DDT and its products in all standard forms and is now



GOOD FOR STEERS—Beef grows meatier nowadays . . . for it's a scientific fact that—compared to untreated cattle—beef-steers gain up to 50 pounds extra when protected from horn flies and many other pests with DDT insecticides.



Knox Out FOR THE HOME—helps to make healthier, more comfortable homes . . . protects your family from dangerous insect pests. Use Knox-Out DDT Powders and Sprays as directed . . . then watch the bugs "bite the dust"!



Knox Out FOR DAIRIES—1 p to 20% more milk . . . more butter . . . more cheese . . . tests prove greater milk production when dairy cows are protected from the annoyances of many insects with DDT insecticides like Knox-Out Stock and Barn Spray.



GOOD FOR FRUITS—Bigger apples, juicier fruits that are free from unsightly worms . . . all benefits resulting from DDT dusts and sprays.



GOOD FOR ROW CROPS—25 more barrels of potatoes per acre . . . actual DDT tests have shown crop increases like this! DDT dusts and sprays help truck farmers pass these gains along to you.



Knox Out FOR INDUSTRY—Food processing plants, laundries, dry cleaning plants, hotels . . . dozens of industries gain effective bug control, more pleasant work conditions with Pennsalt DDT products.



87 Years' Service to Industry • Farm • Home

PENNSYLVANIA SALT MANUFACTURING COMPANY
WIDENER BUILDING, PHILADELPHIA 7, PA.

“The great expectations held for DDT have been realized. During 1946, exhaustive scientific tests have shown that, when properly used, DDT kills a host of destructive insect pests, and is a benefactor of all humanity.

Pennsalt produces DDT and its products in all standard forms and is now one of the country’s largest producers of this amazing insecticide. Today, everyone can enjoy added comfort, health and safety through the insect-killing powers of Pennsalt DDT products . . . and DDT is only one of Pennsalt’s many chemical products which benefit industry, farm and home.

GOOD FOR FRUITS – Bigger apples, juicier fruits that are free from unsightly worms . . . all benefits resulting from DDT dusts and sprays.

GOOD FOR STEERS – Beef grows meatier nowadays . . . for it’s a scientific fact that compared to untreated cattle beef-steers gain up to 50 pounds extra when protected from horn flies and many other pests with DDT insecticides.

FOR THE HOME – Helps to make healthier and more comfortable homes . . . protects your family from dangerous insect pests. Use Knox-Out DDT Powders and Sprays as directed . . . then watch the bugs ‘bite the dust’!

FOR DAIRIES – Up to 20% more milk . . . more butter . . . more cheese . . . tests prove greater milk production when dairy cows are protected from the annoyance of many insects with DDT insecticides like Knox-Out Stock and Barn Spray.

GOOD FOR ROW CROPS – 25 more barrels of potatoes per acre . . . actual DDT tests have shown crop increases like this! DDT dusts and sprays help truck farmers pass these gains along to you.

FOR INDUSTRY – Food processing plants, laundries, dry cleaning plants, hotels . . . dozens of industries gain effective bug control, more pleasant work conditions with Pennsalt DDT products”.

Pennsalt Chemicals, 1947

Turns out that the wonder drug DDT was not quite the “benefactor of all humanity”, that it was once claimed to be!

The first synthetic organochlorine developed was DDT (dichloro-diphenyl-trichloroethane) in 1874; however its broad-spectrum pesticide capabilities were not appreciated until 1939. The Swiss chemist Paul Hermann Müller was awarded the Nobel Prize in Physiology or Medicine in 1948 for his discovery of the high efficacy of DDT as a contact poison against arthropods.

At the outbreak of the Second World War it seemed that a miracle agent had been discovered, that could act as a broad-spectrum pesticide (insecticide and fungicide) that could revolutionize humanity’s battle against agricultural pests and disease carrying insects. It seemed that for the first time in history, malaria and typhus could be

eradicated by the use of this agent against the insect vectors that carried these diseases. During the war it was used extensively to “de-louse” soldiers as well “at risk” civilian populations in order to combat one of the ancient scourges of war - typhus. And it proved remarkably effective. Following the war it was made widely available and was used in malaria eradication programs that targeted the disease carrying mosquitoes that spread it. It was used around the world, again to great effect; many regions were in fact cleared of malaria as a result of DDT. Its use soon spread to agriculture. The eradication of agricultural pests would vastly increase agricultural production and so aid in feeding the world’s billions. Starvation would be a thing of the past.

Production of DDT increased exponentially after the war, and peaked in the 1950s and 1960s, when there was 80 million kilograms of it being produced and used annually. Vast agricultural regions were sprayed with the agent; people were also copiously sprayed as well. DDT was seen as a miracle of the modern age. But then things started to go wrong. It seemed that DDT came at a price. Its indiscriminant use lead to major unsuspected environmental and health disasters. Although highly successful in combating malaria, it also adversely effected wild-life.

Organochlorine compounds are generally very stable compounds that can persist in the environment for long periods of time. They generally degrade slowly and are fat-soluble, meaning that they can accumulate in plants, animals and humans. They can bio-accumulate over time, with the concentrations of organochlorine compounds increasing in animals higher up in the food chain and causing adverse effects in health.

Shortly after the end of the Second World War the U.S. Fish and Wildlife Service started to express concern over the use of DDT and its effects on wild-life. Some pelican populations declined and there was a dramatic decline in the Bald Eagle population almost to extinction.

As explained by Glen Johnson from the Department of Sustainability and Environment, in an interview in 2007:

“...Its in those species which are perhaps at the higher end of the food chain where there is this magnificent term called bioaccumulation that occurs. What happens is there is a gradual accumulation of the pesticide in prey items that are then accumulated and absorbed into the fatty tissues of animals. So particularly things like whales and dolphins that have got large fatty tissues, they end up storing and accumulating a concentrated amount over time that is way beyond the external environmental levels at that time. There have been things associated with wildlife in Australia such as Peregrine Falcons and a whole raft of other species due to egg shell thinning. This resulted in the loss of reproductive output from a whole range of animals so it's been pretty dramatic right throughout the world.”

Johnson goes on to explain the long half-lives of the organochlorines in the environment:

“...Perhaps up to half a century on some and they are highly toxic and have the ability to persist and spread throughout the environment. For instance in the Arctic and

Antarctic where we haven't had the application of some of these things, they are nevertheless in the environment. They are spread by the air and water and do end up in places where they weren't originally applied and have an extremely long potency period."

The environmental hazards of DDT were first brought to the attention of the world as early as 1962, by Rachel Carson in her famous book "The Silent Spring"; one of the earliest and most influential environmentalist works of literature. DDT was banned in the United States in 1972, and in Australia in 1987, however the environmental effects of it are still being felt many years later. Many of the old dump sites, particularly in Russia, for these pesticides are now breaking down and are finding their way into waterway systems. Since its ban in Australia, however there are fortunately signs of recovery from the effects of DDT as seen in the dramatic increase in the reproductive success of a whole range of birds such as Peregrine Falcons.

ORGANOCHLORINE POISONING

Introduction

Chlorinated pesticides were and still are widely used in agriculture, though many that have been used in the past are now banned as environmental, and health hazards.

Lindane is used medically as an anti-lice agent.

Acute ingestions can cause neurological toxicity including **coma** and **seizures**.

These agents should not be confused with **organophosphorous** compounds. There is *no* specific antidote and treatment is supportive.

Toxicity occurs in three main settings:

- Acute deliberate self-poisoning by ingestion.
- Excessive dermal application or accidental ingestion of lindane
- Occupational exposure via dermal or inhalational routes.

Preparations

Most of these compounds are solid at room temperature and so are dissolved in *hydrocarbon solvents* for ready use.

Worldwide a large number of these agents are available, including:

1. Cyclodienes:
 - Aldrin / Dieldrin / Endrin / Hepatchlor / Chlordane / Endosulfan
2. Other agents:
 - Dichloro-diphenyl-trichloroethane, (DDT)/Ethylan/ Hexachlorobenzene/ Isobenzan/ Methoxychlor
3. Medical agents:
 - Lindane as 1% shampoo or lotion.

Toxicology

Lindane and the cyclodienes are neuroexcitatory.

They act as non-competitive antagonists at the chlorine ion channel of the GABA-A receptors.

DDT acts by inhibiting sodium channel closure following depolarization. It is also neuroexcitatory.

Pharmacokinetics

Absorption:

- Following ingestion there is rapid oral absorption
- The degree of dermal absorption will depend on the agent, the concentration, the solvent used with it, (usually a hydrocarbon), and the integrity of the skin.

Lindane and the cyclodienes are well absorbed across the skin.

Distribution:

- The organochlorines are highly lipid soluble and distribute widely to fat stores.
- Accumulation may occur with repeated occupational exposure.

Metabolism and excretion:

- Organochlorines undergo hepatic microsomal metabolism.
- There is non-linear kinetics due to slow redistribution from fat stores and elimination of some organochlorines may take weeks to months.

Risk Assessment

The risk assessment for lindane is relatively well documented as below.

Data for acute and chronic exposure to other agents is sparse.

Dose related risk assessment for lindane:

Children: Doses > 50 mg/kg (5 mls of a 1% solution) will cause symptoms and can be potentially life-threatening.

Topical lindane used as lice treatment can cause agitation and even seizures with repeated or prolonged use. ¹

Adults: Mean lethal ingestion is 125mg/kg

The dose required to produce toxicity from dermal exposure is unknown.

Clinical features

Following acute **ingestion** clinical features will develop within **1-2 hours**

Clinical features develop over **hours to days** following large **dermal** exposures.

1. GIT:

- Nausea and vomiting.

2. Respiratory:

- Aspiration can result in a severe chemical pneumonitis due to hydrocarbon solvents.

3. Neurological:

- Restlessness/ agitation/ confusion.
- Perioral parasthesia
- Fasciculation and myoclonic jerks.
- Drowsiness/ seizures and coma.

4. CVS:

CVS toxicity may be seen in large ingestions.

- Hypotension
- Arrhythmias, these are thought to be due to myocardial sensitization to catecholamines.

5. Hepatic dysfunction

6. Renal dysfunction.

Investigations

1. FBE

2. U&Es/ glucose

3. ABGs if there are significant respiratory symptoms from aspiration.

4. LFTs

5. Consider co-ingestion, blood alcohol, paracetamol.
6. 12 lead ECG and cardiac monitoring.

Management

1. Immediate attention to any ABC issues
2. Dermal exposures:
 - Wash thoroughly with soap and water.
3. Charcoal:
 - Is not indicated. Vomiting may result in aspiration and pneumonitis.
 - It may be given *following* intubation.
4. Agitation and confusion:
 - Control with titrated IV diazepam.
5. Seizures:
 - Control with titrated IV diazepam.
6. Hypotension:
 - Fluid therapy.
7. Ventricular arrhythmias:
 - These are uncommon but if they occur IV beta blockers (e.g. titrated metoprolol) are probably the best agent to use because of myocardial sensitization to catecholamines.

Disposition:

Children with potential ingestions should be observed for 4 hours. If they do not develop symptoms within this time they may be medically cleared.

Excessive dermal exposure only warrants hospital attention should symptoms occur.



British soldiers de-lousing liberated women prisoners of the Bergen-Belsen concentration camp with DDT spray, (to combat insect-born typhus) May 1, 1945, Life Magazine.

References

1. Organochlorines in L. Murray et al. Toxicology Handbook 3rd ed 2015.

Further Reading:

Alison Jess interview with Glen Johnson in: ABC Goulburn Murray News 11 October, 2007

Dr J Hayes

Reviewed July 2017.