Pesticides-I

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Pesticides can be defined as any substance or mixture or substances intended or preventing, destroying, repelling,or mitigating pests. Pests can be insects, rodents, weeds, and a host o other unwanted organisms. Pesticides may be more specifically identified as

- insecticides (insects),
- herbicides (weeds),
- fungicides (fungi and molds),
- rodenticides (rodents),
- molluscides (snails and other mollusks),
- acaricides (mites),

Benefits of pesticides

- They are used in public health programmes to control vector born diseases
- They are used to protect the stored food grains.
- They protect the standing crop in the field. They do not increase the crop yield like fertilizer but by protecting the crop from pests.
- They can be used to control household pests.

Hazards of Pesticides

1. The pesticide industries cause pollution of soil, water and air.The pesticidal residue washed along with rain water, is added to the nearby water resources making it unfit for drinking.
2. They enter the food chain chain and cause problem of bioaccumulation or biomagnification.
3. They are not target specific hence also kills non-pest insects. It adversely affect the mechanism of entomophily.
4. Continuous and indiscriminate use of pesticides may develop resistance in insect pest like superpest and superbugs.

5. They are non-biodegradable and affect the balance of ecosystem.

6.They are highly toxic in nature and if not handled carefully, they can cause serious health problems like cancer, deformities and disease.

7. Accidents in pesticides manufacturing units cause great loss of human life e.g.,

Hazards of Pesticides

Toxic effects on human

- The non-occcupational exposure
- Occupational exposure

Ecotoxic effects

- Water pollution
- Persistent organic compounds thus contrubuting soil contamination
- Reduces biodeversity
- Bioaccumulation, bioconcentration
- Translocation

Non-ocupational exposure

Non-occupational pesticide poisoning was divided into accidental and suicidal. Pesticide poisoning is a major public health problem all over the world. Each year 250 000e370 000 people die from deliberate ingestion of pesticides.1 The World Health Organization (WHO) recognises pesticide poisoning to be the single most important means of suicide worldwide

Although most pesticides (80%) are used in rich countries, most of the poisonings do ensue in poor countries. This is because safety standards are inadequate, there are no protective clothing or washing facilities, insufficient enforcement and poor labelling of pesticides used by farmers who may even not be able to read. Further, few people know enough about pesticide hazards.

In 1979, an old woman who brought Folidol (paration agent) bottle, together the olive oil bottle fried borek with folidol and 16 people who ate the fried borek were poisoned and six of them (6) died in Ödemiş.

Br J Dermatol. 1984 Oct;111(4):413-22.

Porphyria turcica due to hexachlorobenzene: a 20 to 30 year follow-up study on 204 patients.

Cripps DJ, Peters HA, Gocmen A, Dogramici I.

Abstract

During 1955-1961 in south-east Turkey, over 3000 patients developed porphyria due to ingestion of hexachlorobenzene, a fungicide added to wheat seedlings. Subsequently they developed pigmentation, hirsutism, weakness, porphyrinuria and bullae. The condition was called kara yara or 'black sore'. Many of the breast-fed children under the age of 1 year died from a disease known as pembe yara or 'pink sore'. In this follow-up study of 204 patients, 20-30 years later, there were 132 males and 72 females, average age 32.1 years (at time of examination), with an average age of onset of 10.2 years, and duration of 2.4 years. Neurological, dermatological, and orthopaedic abnormalities still persisted. Neurological symptoms included weakness (66%), paraesthesiae (54%), neuritis (63%), myotonia (49%), and occasional 'cogwheeling' (29%). Some individuals affected before puberty had small stature (44%), small hands (64%) and painless arthritis (67%). Severe residual scarring was common (85%), and pinched facies (42%), hirsutism (47%) and hyperpigmentation (71%) were also observed. Enlarged thyroids were observed in 37% (59% in females), which was above average of 5% in this area of Turkey. Porphyrin excretion, particularly uroporphyrin in the urine and stools, was still significantly increased in seventeen patients. Hexachlorobenzene levels as high as 2.8 p.p.m. were detected in human milk, and the average level (0.29 p.p.m. +/- s.d. 0.06) was 140 times the level allowed in cow's milk.

Occupational Exposure

Occupational exposure to pesticides occurs directly during manufacture of the product, during transport and storage, and during preparation and spreading by the user, but also during re-entry into treated fields, harvest and equipment cleaning. In agriculture, **most pesticides enter the body dermally, followed by respiratory and oral routes .** Pesticide inhalation mainly occurs during fumigation, mixture preparation and/or application in closed environments .

A leak of MIC used in the production of **carbaryl (sevin)** caused the Bhopal disaster, the most lethal industrial accident in history.

POPs (Persistent Organic Pollutants)- Stockholm Convention

Persistent Organic Pollutants (POPs) are chemical substances that persist in the environment. The most important features of POPs are bioaccumulation and toxicity. POPs are organic compounds and highly resistant against chemical and biological degradation.

POPs can pass to the fetus through the placenta and can pass through breast milk to the baby. As widely distributed, bioaccumulation and persistence of POPs, none of the governments can protect human health or environment alone from POPs. In this context, The Stockholm Convention was founded in Stockholm, Sweden in 2001 to protect human health and the environment from POPs. The main objective of the Stockholm Convention is, to ban or restrict the use, production, imports and exports of the POPs. Convention brings the various regulations or requirements about, all processes from production to disposal of POPs and POPs produced as a byproduct.

INCESTICIDES

Insecticides play a most relevant role in the control of insect pests, particularly in developing countries. All of the chemical insecticides in use today are neurotoxicants, and act by poisoning the nervous systems of the target organisms.

The central nervous system of insects is highly developed and not unlike that of mammals. As a class, insecticides have high acute toxicity toward nontarget species compared with other pesticides. Some of them, most notably the organophosphates, are involved in a great number of human poisonings and deaths each year

Insectisides can be classified

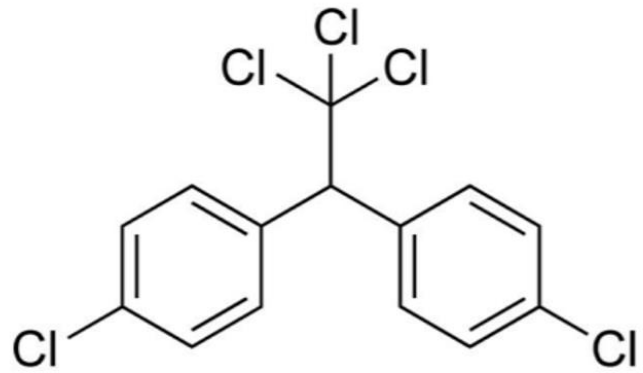
- Organochlorine Compounds
- Organophosphorus Compounds
- Carbamates
- Pyrethroids

Organochlorine Compounds

The organochlorine insecticides include the chlorinated ethane derivatives, such as DDT and its analogs; the cyclodienes, such as chlordane, aldrin, dieldrin, heptachlor, endrin, and toxaphene; the hexachlorocyclohexanes, such as lindane; and the caged structures mirex and chlordecone.

Their acute toxicity is moderate (less than that of organophosphates), but chronic exposure may be associated with adverse health efects particularly in the **liver and endocrine disruption of the reproductive system**.

DDT and Its Analogs—DDT is effective against a wide variety of agricultural pests, as well as against insects that transmit some of the world's most serious diseases, such as typhus, malaria, and yellow ever. DDT has a moderate oral acute toxicity and its dermal absorption is very limited



DDT-Dichloro diphenyl trichloroetan

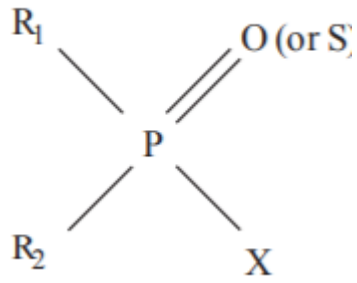
On absorption, DDT distributes in all tissues, and the highest concentrations are found in adipose tissue. It is excreted through the bile, urine, and milk. An important target or chronic DDT exposure is the liver.

DDT and its breakdown product DDE increase liver weight and cause hepatic cell hypertrophy and necrosis, and they are potent inducers o cytochrome P450s, particularly CYP2B and CYP3A. Both DDE and DDD, another breakdown product, are carcinogenic in rodents, causing primarily an increase in hepatic tumors.

DDT and Public Health: Risk–Benefit Considerations—
The Stockholm Convention on Persistent Organic Pollutants, signed in 2004 by 50 states, outlawed the use of 12 industrial chemicals (the “Dirty Dozen”), including DDT . Yet, an exemption clause allows malaria-endemic nations to continue utilizing DDT or indoor residual wall spraying. The United Nations Environment Program estimates that about 25 countries would use DDT under this exemption from its ban. This situation is keeping the debate on the risks and benefits of DDT usage very much alive.

Organophosphorus Compounds

The general structure of organophosphorus (OP) insecticides can be represented by:where X is the so-called leaving group that is displaced when the OP phosphorylates acetylcholinesterase (AChE), and is the most sensitive to hydrolysis; R1 and R2 are commonly alkoxy groups (i.e., OCH3 or OC2H5) or other chemical substituents; either an oxygen or a sulphur (in this case the compound should be defined as a phosphorothioate) is also attached to the phosphorus with a double bond.



Biotransformation—For all compounds that contain a sulphur bound to the phosphorus, a metabolic bioactivation is necessary or their biological activity to be manifest, as only compounds with a P= O moiety are e ective inhibitors o AChE. Oxidative desulphuration (leads to the ormation o an “oxon,” or oxygen analog o the parent insecticide) and thio- ether oxidation (formation of a sulph oxide, S= O, followed by the formation of a sulphone, O= S= O) are catalyzed by cytochrome P450s. Catalytic hydrolysis by phosphotriesterases, known as A-esterases (which are not inhibited by OPs), plays an important role in the detoxication o certain OPs. Noncatalytic hydrolysis of OPs also occurs when these compounds phosphorylate serine esterases classified as B-esterases.

Signs and Symptoms of Toxicity and Mechanism of Action—OP insecticides have high acute toxicity, with oral LD50 values in rat often below 50 mg/kg. For several OPs, acute dermal toxicity is also high. Inhibition o AChE by OPs causes accumulation o acetylcholine at cholinergic synapses, with overstimulation of muscarinic and nicotinic cholinergic receptors. As these receptors are localized in most organs o the body, a “cholinergic syndrome” ensues, which includes increased sweating, salivation, bronchial secretion, bronchoconstriction, miosis, increased gastrointestinal motility, diarrhea, tremors, muscular twitching, and various central nervous system effects. Whereas respiratory failure is a hallmark of severe OP poisoning, mild poisoning and/or early stages of an otherwise severe poisoning may display no clear-cut signs and symptoms.

Reactivation o phosphorylated AChE does not occur once the enzyme-inhibitor complex has “aged,” which occurs when there is loss by nonenzymatic hydrolysis o one o the two alkyl (R) groups. When phosphorylated AChE has aged, the enzyme is considered to be irreversibly inhibited, and the only means of replacing its activity is through synthesis of new enzyme, a process that may take days.

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Treatment of Poisoning

Procedures aimed at decontamination and/or at minimizing absorption depend on the route o exposure. In case o dermal exposure, contaminated clothing should be removed, and the skin washed thoroughly with alkaline soap. In case of ingestion, procedures to reduce absorption from the gastrointestinal tract do not appear to be very efective.

Atropine, a muscarinic receptor antagonist, prevents the action o accumulating acetylcholine on these receptors. The administration of pralidoxime (2-PAM) early after OP exposure can help prevent AChE aging, but its efectiveness is equivocal and harm may ensue. Diazepam may be used to relieve anxiety in mild cases, and to reduce muscle asciculations and control convulsions in the more severe cases.

Carbamates

Carbamate insecticides are derived rom carbamic acid, and most are N-methylcarbamates. Acute oral toxicity ranges from moderate to low toxicity, such as carbaryl (sevin), to extremely high toxicity, such as aldicarb. Dermal skin penetration by carbamates is increased by organic solvents and emulsifers present in most formulations. Carbamates are susceptible to a variety o enzyme-catalyzed biotransformation reactions, and the principal pathways involve oxidation and hydrolysis. The mechanism o toxicity o carbamates is by inhibition o AChE, which is rapidly reversible.

The signs and symptoms o carbamate poisoning include miosis, urination, diarrhea, salivation, muscle fasciculation, and CNS effects (able 22–4). Acute intoxication by carbamates is generally resolved within a few hours. The treatment of carbamate intoxication relies on the use o atropine. Carbamates can inhibit neuropathy target esterase (NTE).

Methylcarbamates are not mutagenic, and there is no evidence of carcinogenicity. Embryotoxicity or fetotoxicity is observed only at maternally toxic doses. Limited evidence suggests that carbamates (e.g., aldicarb) may be more acutely toxic to young animals than to adults, possibly because o lower
detoxication.

Pyrethroids

Pyrethrins were first developed as insecticides from extracts of the flower heads of Chrysanthemum cinerariaefolium, whose insecticidal potential was appreciated in ancient China and Persia. Because pyrethrins decompose rapidly on exposure to light, the synthetic pyrethroid analogs were developed. Because o their high insecticidal potency, relatively low mammalian toxicity, lack o environmental persistence, and relatively low tendency to induce insect resistance, pyrethroids now account or 15% to 20% of the global insecticide market. The pyrethroids are used widely as insecticides both in the house and in agriculture, in medicine or the topical treatment of scabies and head lice, and in tropical countries in soaked bed nets to prevent mosquito bites.

Pyrethroids alter the normal function of insect nerves by modifying the kinetics of voltage-sensitive sodium channels, which mediate the transient increase in the sodium permeability of the nerve membrane that underlies the nerve action potential.

On absorption, pyrethroids are very rapidly metabolized through two major biotransformation routes: hydrolysis or oxidation by cytochrome P450s. These initial reactions are followed by conjugation with sulphate or glucuronide.

Signs and Symptoms of Toxicity and Mechanism of Action—Based on toxic signs in rats, pyrethroids have been divided into two types. Type I compounds produce a syndrome consisting of marked behavioral arousal, aggressive sparring, increased startle response, and ne body tremor progressing to whole-body tremor and prostration (type I or syndrome). Type II compounds produce profuse salivation, coarse tremor progressing to choreoathetosis, and clonic seizures (type II or CS syndrome).

On occupational exposure, the primary adverse effect resulting rom dermal contact with pyrethroids is paresthesia. Symptoms include continuous tingling or pricking or, when more severe, burning. The condition reverses in about 24 h, and topical application of vitamin E has been shown to be an effective treatment. Paresthesia is presumably due to pyrethroid induced abnormal repetitive activity in skin nerve terminals.

Chronic studies with pyrethroids indicate that at high dose levels they cause slight liver enlargement often accompanied by some histopathologic changes. There is little evidence of teratogenicity and mutagenicity. An increased rate of lymphoma incidence in rodents has been reported or deltamethrin, but the effect was not dose-dependent.

INSECT REPELLENTS

Insect-transmitted diseases remain a major source o illness and death worldwide, as mosquitoes alone transmit disease to more than 700 million persons annually. DEET (N,N-diethyl-m toluamide or N,N-diethyl-3-methylbenzamide) is very effective at repelling insects, ticks and flies.Subchronic toxicity studies in various species did not reveal major toxic efects and no significant efects of DEET were seen in mutagenicity, reproductive toxicity, and carcinogenicity studies. Acute and chronic neurotoxicity studies also provided negative results. However, in children DEET is possibly responsible or neurotoxic efects and children should only be exposed to products with up to 10% DEET .

References

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