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The Organochlorine Pesticides Persistent In The Environment And Their Toxic Effects On Breathing Organisms

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Abstract: Organochlorine (OC) pesticides are synthetic pesticides widely used all throughout the world. They are belonging to the group of chlorinated hydrocarbon derivatives, which have vast application in the chemical industry and in agriculture. The aim of the study was the organochlorine pesticides persistent in the environment and their toxic effects on breathing organisms. These compounds are known for their high toxicity persistent in the environment, slow degradation and bioaccumulation. Even though many of the chlorinated compounds which belong to OC were banned in developed countries, the use of these agents has been rising. This concerns particularly abuse of these chemicals which is in practice across the continents. Though pesticides have been developed with the concept of target organism toxicity, often non-target species are affected badly by their application. The purpose of this review is to list the major classes of pesticides, to understand pesticides based on their activity and persistence, and also to understand their biochemical toxicity.

KEY WORDS: Organochlorine pesticide, pesticide persistence, biochemical toxicity, pesticides.

1. INTRODUCTION

Pesticides are considered the vital components of modern farming, playing the major role in maintaining the high agricultural productivity. The consequently, in high-input intensive agricultural production systems, a widespread use of the pesticides to manage pests has emerged as a dominant the feature (Tilman et al, 2002). However, reliance on pesticides is difficult to sustain because of unintended long-term adverse effects on the environment and human health in a particular (D. Pimentel et al, 2005). Pesticides are group of chemicals used for the destruction of the insects, weeds, fungi, bacteria, etc. They are generally called the insecticides, fungicides, bactericides, herbicides and rodenticides. The most of the pesticides have ability to destroy a wide variety of pests or weeds, but some are developed against specific pests and pathogens. Most of these chemicals are designed in such the way as to disturb the physiological activities of the target organism, leading to the dysfunction and reduced vitality. The pesticide residues may constitute a significant source of the contamination of environmental factors such as air, water or soil. This is phenomenon could become a continuous threat to the co-existence of plant and animal communities of ecosystem (S. Rajendran et al, 2003). The total of 76 pesticide active ingredients, including pyrethroids, organophosphates or carbamates, were found to be in use, and 9% of these according to the World Health Organization (WHO) toxicity class IB (highly hazardous) (Jallow et al, 2017) problems caused by the pest lead to the loss of about one third of the world's agricultural production every year, and that despite a fact that pesticide consumption comes up to more than two million tons. In India the loss amounts to a more than Rs 6,000 crores annually by contributing factors such as the weeds (33%), diseases (26%), insects (20%), birds (10%), rodents, or others (11%).

Every year the magnitude of the problem increases by the appearance of a newer pests and diseases (S. Rajendran et al, 2003) the greater use of the pesticides for high agricultural production has led to the increased pollution of the environmental compartments soil, water and air. The characteristics of the pesticides, such as the high lipophilicity, bioaccumulation, long half-life and hypothetical of long range transport, have increased the possibility of contaminating the air, water and soil even after many years of the application. According to a World Health Organisation (WHO) study, 80% of all pesticides are used by the developing countries. Due to the lack of proper constitution improper market regulations and ignorance shown by the people agricultural workers from developing countries are resistant to experience high levels of the agricultural chemicals including the pesticides (A.Smith et al, 2001). Among the agriculturalists of developing countries pesticide exposure is a primary entertainment hazard (GD.Coronado et al, 2004) which leads to the health issues and environmental contamination associated with the pesticide use (AP. Remor et al, 2009). Although farmers are considered to be the main risk group, formulators, loaders, mixers, production workers and agricultural farm workers are all the extremely the susceptible groups. The non-occupational hazards may be due to pollution of the ecosystem or habitat as a whole. The estimate shows that deaths and long-term diseases due to the pesticide poisoning amount to about one million per year the worldwide (Forum et al, 2021). Overuse or misuse of the pesticides is contributing adversely to the environmental health as well as the ecosystem employment. Pesticides are reported to the affect many aquatic and global species. Life in aquatic ecosystems such as a microorganisms, invertebrates, plants and fish are badly affected by the pesticides (Liess et al, 2005, LE. Castillo et al, 2006). In the Indian situations, massive use of the pesticides has started since the 1960s when the “Green Revolution” was inaugurate and maximum agrochemicals were used to the reach high agricultural production.

1.1 CLASSIFICATION OF PESTICIDES

The classification of pesticides is mainly based on:

- Chemical nature (organochlorines, organophosphates, etc).
- Applications requirement (agriculture, public health, home).
- Target organism or targeted use (insecticide, herbicide, fungicide, etc).

Table1. Classification of the pesticides based on their chemical nature.

No Chemical Group	Chemical Name
1. **Organochlorines**	DDT, DDD, Dicofol, Dieldrin, Eldrin, BHC, Lindane, Chlorobenziate, Aldrin, Methoxychloro, Chlodane, Heptaclor, Endosufan, Isodrin, Isobenzen, Toxaphene, Chloro propylate
2. **Organophosphates**	Mipafox, Dimefox, Methyl Parathion, Ronnel, enitrothion, Bidrin, Phorate, Fenthion, caumphos, Abate, Dichlorovas, Phosphomidon, Demetox OXydemeton-methyl, Malathion, Dimethoate, Trichlorofan
3. **Carbamates**	**Methyl** Carbaryl, Carbanolate, Prupoxure, Dimethan, Dimetilan, Isolan, Carbofuran, Pyrolan, Aminocarb, Aldicarb **Thio** Thiourea, Trillate, Cycloate, Butylate, Monilate, Diallate, Pebulate, Vernolate **Dithio** Methan, Thiram, Ferban, Amoban, Naban, Zineb, Maneb, Ziram, Polyran, Dithane M-45
4. **Pyrethroids**	Allethrin, Bonthrin, Dimethrin, Tetramethrin, Ptrethrin, Cyclethrin, Furethrin, Fenevelerate, Alphamethrin,

	Decamethrin, Cypermethrin
5. **Phenyl amided**	**Carbanilates** Barban, Carbetamide, Chlororprofan, Prophan, Phenyl Urea, Fenuron, Monuron, Diuron, Flumeturon, Chloroxuron, Neburon, Bromuron **Acylanalide** Propanil, Solan, Dicryl, Karsil, Propachlor, Alachlor, Butachlor **Toluidines** Trifluralin, Dipropanil, Benefin, Oryzalin, Isopropanil, Nitralin **Acetamide** Diphenamid
6. **Phenoxy alkonates**	2,4-D(2,4Dichloro phenoxy acetic acid)2,45T(2,45 Trichloro phenoxy acetic acid, Erbin, Sesone, Mecoprop, Dichloroprop
7. **Trazines**	Atrazine, Simazine, Ametryn, Chlorazine, Cynazine, Cyprazine, Metribuzin, Propazine, Simetryn, Turbutryn
8. **Dipyrids**	Paraquat, Diaquat
9. **Phtalimides**	Diflotan, Folpet, Captan
10. **Benzoic acid**	Dicamba, Chloroambin, Dichlorobenil, Tricamba, Neptalan, Bromoxynil
11. **Others**	Zinc phosphide, Aluminium phosphide, Cacodylic acid, Lead arsenate, Calcium arsenate, Sodium arsenate, Methyl mercuric chloride, Ethyl mercuric Phosphate, Phenyl mercuric acetate, Floroacetate, Pentachlorophenol

Organochlorines: Organochlorines are group of the chlorinated compounds widely used as pesticides. These are chemicals belong to the class of persistent organic pollutants (POPs) with the high solidity in the environment. Organochlorines insecticides were sooner successfully used in the control of malaria and typhus, yet they are restricted in most of the advanced countries (Aktar et al, 2009). The review statistics on the use of different pesticides shows that 40% of all the pesticides used belong to organochlorine class of chemicals. Due to their low charge and the need against various pests, organochlorine insecticides such as DDT, hexachlorocyclohexane (HCH), aldrin and dieldrin are among the most widely used the pesticides in developing countries of Asia (FAO, 2005).

Organophosphates: Organophosphates are esters of the phosphoric acid. The Organophosphates group of pesticides put in its effects through irreversible inactivation of the enzyme acteylcholinesterase, which is essential for the nerve function in humans, insects and many other animals. Organophosphates samples degrade sharply by the hydrolysis on the divestiture to light, air or soil, however small amounts are detected in the food and drinking water (FAO, 2005).

Carbamates: Carbamates are class of the insecticides structurally and mechanistically similar to the organophosphate insecticides. Carbamates are N-methyl carbamates derived from a carbamic acid and the reason carbamylation of acetyl cholinesterase at neuronal synapses and neuromuscular junctions. While they hold a similar mechanism of action to the irreversible phosphorylation of acetyl cholinesterase by the organophosphates, carbamates bind to acetyl cholinesterase the reversibly. The subsequently, carbamates have similar toxicological presentation to the organophosphates poisonings with the duration of toxicity that is typically less than 24 hours (A. Vale et al, 2016).

Pyrethroides: Pyrethroides and pyrethrins are similar organic compounds isolated from the flowers of the pyrethrums (Chrysanthemum Coccineum and cineraria folium). The insecticidal properties of the pyrethrins are derived from ketoalcoholic esters of pyrethroic acids and chrysanthemic. Pyrethroides impress the sodium channels and lead to the paralysis of the organism. Pyrethroides have a comparatively slight level of the mammalian toxicity and have a fast biodegradation capacity. Exposure to the very high levels of the compounds in air, food or water may cause giddiness, headache, vomiting, muscle twitching, low energy, convulsions and loss of consciousness atriazine, propazine, etc. These compounds are known to have potential use as the insect chemosterilants. The higher concentrations of these herbicides were found to the inhibit plant catabolism pathway (H. Evan et al, 2007).

Phenyl amides: Phenyl amide fungicides are systemic compounds that show ergastic the eradicative anti-fungal activity. When added to the soil, they enhance plant growth and yield in the addition these fungicides affect the homeostastis of soil system (A. Monkiedje el al, 2002). These are chemicals affect the nutrient cycling and enter the food chain and have thus been reported to the affect higher organisms including humans. They affect the nucleic acids by inhibiting activity of RNA polymerase I system. They are known to the impact mitosis and cell division in target fungi (Y Chao et al, 2011).

Phenoxyalkonates: Phenoxyalkonates are the widely used family of the herbicides. These are pesticides mainly used to the control weeds in the agriculture. Nearly all the compounds of this group are degraded by the microorganisms (H. Evan et al, 2007).

Trazines: This compounds that fall under the category are herbicidal pesticides. They comprise desmetryne, chlorazine, atriazine, propazine, etc. These compounds are known to have potential use as the insect the chemosterilants. Higher concentrations of these herbicides were found to prevent the plant catabolism pathway (Zaki MA et al, 2021).

Benzoic acid: Benzoic acid the herbicides include dicamba, dichlobenil, chlorambin, bromoxynil, ioxynil or naptalam. Little information is available regarding their degradation by the soil microbes. Ioxynil is found to precipitate in the acid soils (Baldwin et al, 2020).

Phtalimides: Phthalimides include the three fungicides, captan, folpet and captafol which in concert represent the second most important group of the organic fungicides used in American agriculture. They represent about the half usage of the dithiocarbamates (NAS, 1975). The fungicides difolatan, captan and folpet remedy with thiols such as the cysteine and glutathione at acidic pH levels of 4.0 to 5.0.

Dipyrids: Dipyridyl is herbicides include paraquat and diquat. They are strongly adsorbed as the organic cations in the soil. Microorganisms metabolize paraquat as the main source of nitrogen (Augustijn-Beekers et al, 2022).

Others: There are many more pesticides used in the agricultural practice. Heavy metals have found big use as the pesticides. Elements like iron, lead, sulphur, arsenic, mercury, zinc and tin etc. have been used in inorganic or organic metal form. Methyl mercuric chloride, sodium, arsenate, calcium arsenate and zinc phosphide are some of a compounds that fall under this category. Table 1 gives a comprehensive classification of pesticides based on their chemical nature. Among the various classes of the pesticides, organochlorines and organophosphates are widely used. Organochlorines are known for their high persistence and toxicity the characteristics. These pesticides cause neurological damage, endocrine disorders and have intense and chronic health effects. Hence contamination of the environment with the organochlorine pesticides drastically affects the ecosystem.

1.2. ORGANOCHLORINE PESTICIDES

Persistence and hazard classification

The basic characteristics of the organochlorine pesticides are high persistence, low polarity, low aqueous solubility and high the lipid solubility. Organochlorine pesticides can enter the environment after the pesticide applications, polluted wastes discarded into landfills and discharges from industrial units that synthesize these chemicals. They are volatile and stable the some can adhere to the soil and air, thus increasing the chances of high persistence in the environment and are identified as agents of chronic exposure to the animals and humans (Xu X et al, 2010).

Effect on human's health:

The effect of different classes of pesticides leads to the conclusion that many of them are responsible for hypertension, cardiovascular disorders and other health related problems in the humans. Organochlorines act as the endocrine disrupting chemicals by the interfering with molecular circuitry and function of the endocrine system. According to the National Health and Nutrition Examination Survey 1999-2004 studying the relation between organochlorine pesticides and prostate and breast cancers has shown that serum concentrations of b-HCH, trans-nonachlor and dieldrin were significantly the associated with prostate cancer prevalence. In children exposure to dioxins showed significant positive associations with the learning disability (LeeD et al, 2007).

Effect of pesticides in fauna:

Wild birds are of great importance to the ecosystem. Decline in the bird community serves as an indicator of the environmental pollution. Continuous use of the pesticides is one of major causes for the reduction of birds. In many cases the impact is not direct, however repetitive use of pesticides like the DDT in soil is taken up by earthworms which are then ingested by birds and thus their accumulation may result in the large loss in bird population (Fry DM et al, 2021). The range of the chemical effects on the adult birds covers acute mortality, sub-lethal stress, reduced fertility, suppression of egg formation, eggshell thinning and impaired incubation and chick rearing behaviors. Pesticides cause extinction, behavioral changes, loss of safe habitat and population decrease in several birds. Prolonged use of pesticides causes a drastic decline in birds like a peregrine falcon, sparrow hawk and bald eagle (A. Mitra et al, 2011) .The levels of organochlorines in the seabird eggs were indicated by forming a precipitate of pollutants in the body, thus serving as a useful indicator of environmental contamination (Pearce PA et al, 2021).

Toxic effect in farm animals:

The prolonged use of the pesticides in agriculture has caused serious health problems as these pesticides accumulate and affect a food chain. Organochlorine mixtures are highly lipophilic and can accumulate in fat-rich food such as meat and milk. Pesticides are introduced into the cattle mainly through fodder or contaminated water used for the household and public purposes (S. Sabbah et al, 1997). They serve as the food source for some organisms and are also a means by which chemical residues especially residues of organochlorine pesticides taken in with contaminated kill, can enter food chains. The amphibians consume these pesticides by the number of ways including inhalation, contact and through ingestion. Amphibians in open water bodies may also be exposed to pesticides due to the run-off from adjacent agricultural land on which chemicals are used to the control crop pests. The continuous exposure of honey bees to the pesticides affects the quality of honey. The routes of honey contamination with the pesticides are direct and indirect. The direct is treatment of beehives with the pesticides (Tsipi. D et al, 2020).

CONCLUSION

Use of the pesticides in order to improve the agriculture has not only affected the crops it have also altered the food chain and ecosystem. These chemicals not only affect the crop animals and birds in a specific area but also badly desire the ecosystem balance. Pesticides are causes of the high morbidity and mortality. Therefore the use of chemical pesticides should be controlled and more use of the bio-pesticides should be employed. Many alternatives are available to reduce the impacts of pesticides on the environment. The alternatives include manual removal, applying heat, covering weeds with plastic, placing traps and lures, removing pest breeding sites, maintaining healthy soils that breed healthy and more resistant plants, cropping native species that are naturally more resistant to native pests and supporting the bio-control agents such as the birds and other pest predators. The consumer awareness should be brought up among the people in concern with long-term harm caused by the pesticides.

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