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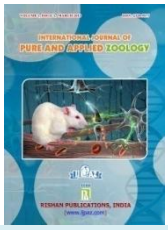

RESEARCH ARTICLE **OPEN ACCESS**

RESIDUES OF ORGANOCHLORINE PESTICIDES IN FISHES FROM THE MUMBAI WEST COAST OF INDIA

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ABSTRACT

Organochlorine pesticides, such as HCH (Hexachlorocyclohexane) and DDT (dichloro diphenyl trichloro ethane) and its metabolites were analysed in commercially important fishes, collected from the Dadar fish market (Mumbai) in July 2011. Total DDT concentration varied between 14.88 and 58.30 ng.g-1 in the *Lisa parsia and Chirocentrus dorab* respectively. The minimum and maximum concentrations of total HCH were 4.96 and 19.12 ng.g-1 in the same two species are *Lisa parsia* and *Chirocentrus dorab* respectively. In total HCH, the alpha isomer was recorded at very high level when compared with other isomers. Similarly was the dominant metabolic compound in total DDT in all the fish species. The residual concentration of the pesticides in fishes was well below the tolerance limits prescribed.

Key words: *Fishes, Organochlorine, Pesticides residues, GC-ECD, West coast, Mumbai, India.*

INTRODUCTION

Organochlorine herbicide/ pesticide pollution severely affects aquatic organisms at higher trophic levels including human beings (Nwani *et al*., 2010). The effects of pesticides on fishes are of great concern (Bagheri and Nezami, 2000 and Nwani *et al*., 2010). The effects of insecticides on fish are well documented. Fishes are good bio-indicators of environmental pollution monitoring and can play significant roles in assessing potential risk associated with contamination in the aquatic environment as they are directly exposed to chemicals resulting from agricultural production or indirectly through the food chain of an ecosystem (Lakra and Nagpure, 2009). Organochlorine pesticides have remained major pollutants with numerous investigations reporting the continued and ubiquitous presence of Organochlorine pesticides in the globally (Hung *et al*., 2002). Organochlorine pesticides are very stable compounds for example the degradation of dichlorodiphenyltrichloroethane (DDT) in soil ranges from 4 to 30 years. (Afful *et al*., 2010). Organochlorine pesticides have also been reported to cause human breast and liver cancers, testicular tumours and lower sperm counts (Davies and Barlow, 1995). They chemicals liposoluble compounds and are capable of bioaccumulating in the fatty parts of organs such as breast milk, blood and fatty tissues (William *et al*., 2008). Since the pesticides are lipophilic in nature, their cumulative accumulation at low concentrations in the fat tissues of mammal might pose potential hazards in the long run (Metcaff, 1997).

India is a tropical country where persistent pesticides like HCH and DDT are being used for control of pests of an agriculture and public health importance. Moreover India is the largest producer and consumer of pesticides in South Asia and a pesticide use has increased in the last three decades. The consumption of pesticides in India has risen from 2000 metric tons a year in the fifties to over 80,000 metric tons in recent years **(**Karunagaran *et al.,* 1994). The human population in developing countries is known to carry heavy burdens of pesticide residues.

Fish are group of great importance for man as a major source of proteins, vitamins. On the other hand they act as a main route for the accumulation of such toxic chemicals from pesticides to human bodies.

Industrial wastes have long been recognized as serious pollutant of the aquatic environment**.** Pesticides have toxic effect in exposed organism. The presence of pesticides beyond permissible limits in water bodies has been reported worldwide**.** Our study focuses on the toxic effect of pesticides on fish. Most of seas are seriously polluted with industrial effluents. All the chemicals of industrial waste are toxic to animal and many cases of death or sub-lethal pathology of liver, kidney, reproductive system, nervous system of fishes have been reported. Pesticides are pollutants which affect the aquatic fish presence of pesticides show alternation of behaviour, bioaccumulation of pesticides in the body of fish histopathological and biochemical alternations. (Mukesh Kumar Napit, 2012).

Present investigation was made in order to know the concentration and distribution of these contaminants in fishes of various kinds (Planktonivorous and Carnivorous) from Mumbai coastal region. Mumbai is the Manchester of India, highly industrialized and densely populated metropolitan city. The vast development of industries, harbour activities and urbanization are the main sources for the different kinds of pollutants to the Mumbai coastal environment.

MATERIALS AND METHODS

Ten fish samples (various sizes between 5-18 cm length and 2-6 cm depth) were collected from Dadar fish market (Mumbai) on July 21, 2011 after inquisition of the location where the samples had been caught by the fishermen. After identification, muscle portion of fish was preserved in 5% formalin. Methodology of (Tanabe *et al.,* 1984) was followed for residue analysis. The tissue (20g) was thoroughly homogenised with anhydrous Na_2SO_4 and subjected to soxhlet extraction for six hours with a mixture of n-hexane and diethyl ether (3:1). Lipid content was determined gravimetrically by evaporating a known volume of the extract. The remaining extract was condensed in a Kuderno-Danish (K.D.) evaporator and treated through florisil clean up. Then the extract was fractionated using silica gel packed in a glass column. The first fraction eluted with hexane contained *p,p'*-DDE and second fraction eluted with 20% dichloromethane in hexane contains the HCH isomers (alpha, beta, gamma and delta) *p,p'*-DDD *o,p'*-DDT and *p,p'*-DDT. Each elute was concentrated and then washed with 50% fuming sulphuric acid and hexane washed water.

Identification and quantification of pesticide residues were done in a GC (Hewlett Packard 5890 series II) with 3% OV-1 glass column and ECD (63 Ni). Injector and detector temperatures were 275^0C and 300^0C respectively. The oven temperature was 191^0C held for 12 min and programmed to 216^OC at 5^0C min-1 and held for 20 minutes. Nitrogen at a flow rate of 30 ml min-1 was used as carrier gas. Residues were quantified by comparing peak heights with the corresponding peak heights of standards (Ultra Scientific Co., USA). The retention times

(minutes) of isomers are given in parentheses alpha'-HCH (3.74), beta'-HCH (5.22), gamma'- HCH (4.92), Delta'-HCH (6.605), *p,p'*-DDE (16.37), *p,p'*-DDD (26.1), *o,p'*-DDT (22.2) and *p,p'*-DDT (32.88).

RESULTS AND DISCUSSION

Fish are used extensively for environmental monitoring because they take contaminants directly from water and diet (Lanfranchi *et al*., 2006). Generally the ability of fish to metabolize organochlorines is moderate; therefore, contaminant loading in fish is reflective of the state of pollution in the surrounding environment (Guo *et al*., 2008). Organochlorine pesticides have become ubiquitous contaminants and implicated in a broad range of deleterious health effects in laboratory animals and man. The toxic effect includes reproductive failures and effect on human beings Immune system malfunction, endocrine disruption and breast cancers. (Garabrant *et al*., 1992; Kolpin *et al*., 1998; Bouman, 2004; Ize *et al*., 2007; Adeyemi and Ukpo, 2008) Many of these Oranochlorine pesticides and their metabolites have also been implicated in a wide range of adverse human and environmental effects including reproduction and birth defects (Edwards, 1987). The concentrations (ng.g-1) of total HCH and total DDT fishes are shown in Fig. 1 and their percentage compositions are shown in Fig. 2 and Fig. 3. The marine fishes from the Mumbai coast had relatively low levels of total DDT compared to the values reported by 0.86'-140 ng.g-1 (Kannan *et al*., 1992). In fishes from fish markets of some other metropolitan cities of India by (Burns *et al*., 1982) in fishes from Oman coast the range was (15'-3200 ng.g-1). Of the 10 fish samples of the present study the highest value of (19.1 and 58.30 ng.g-1) was recorded in the carnivorous fish *Chirocentrus dorab* for HCH and DDT respectively.

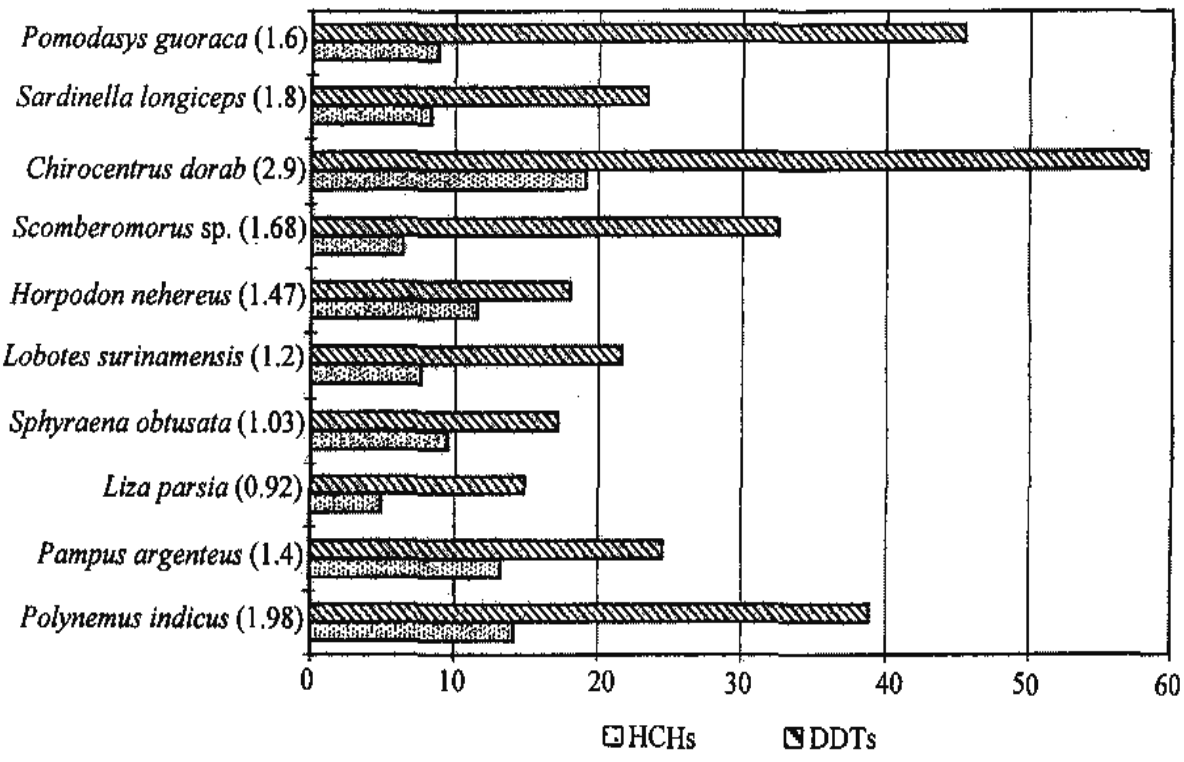

Figure 1. Total HCH and DDT concentrations (ng g^{-1}) in the fishes collected from Dadar (Mumbai) fish market (values in parenthesis indicate fat content in percent).

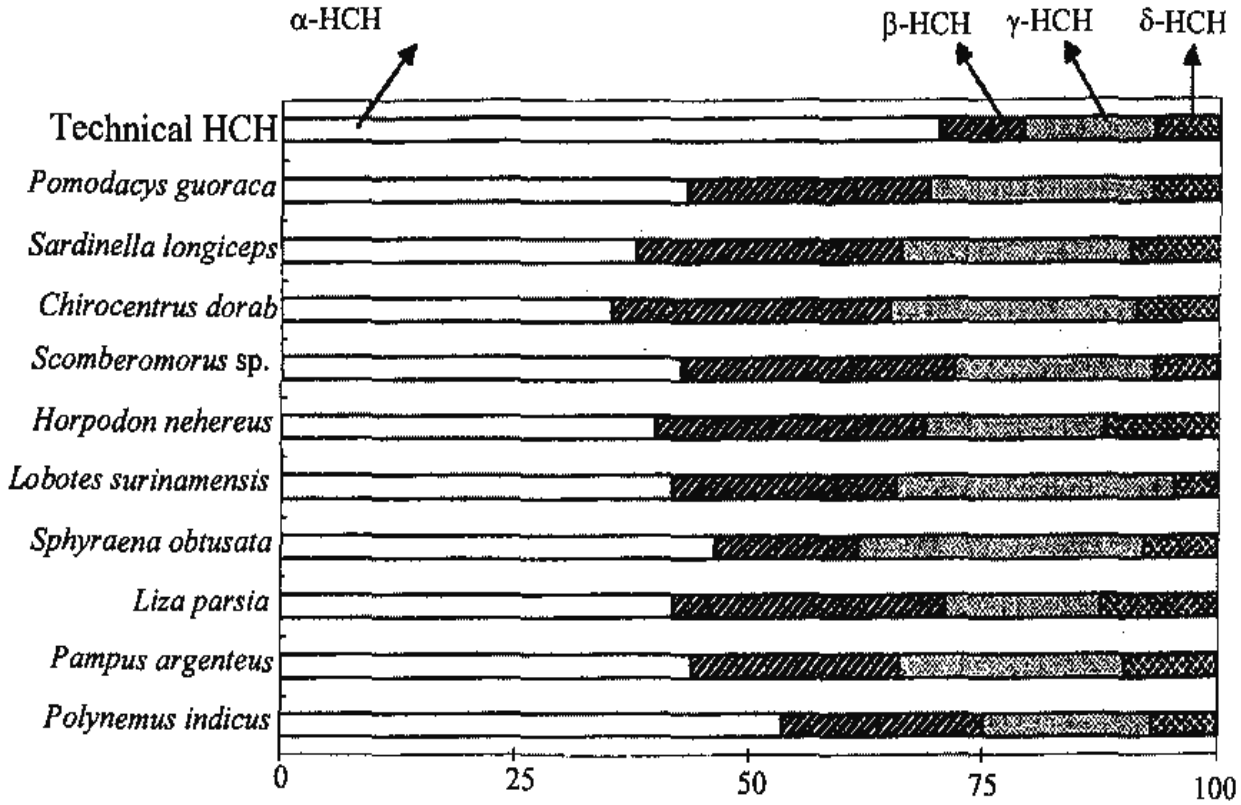

Figure 2. Percentage composition of HCH isomers in the fishes collected from Dadar fish market.

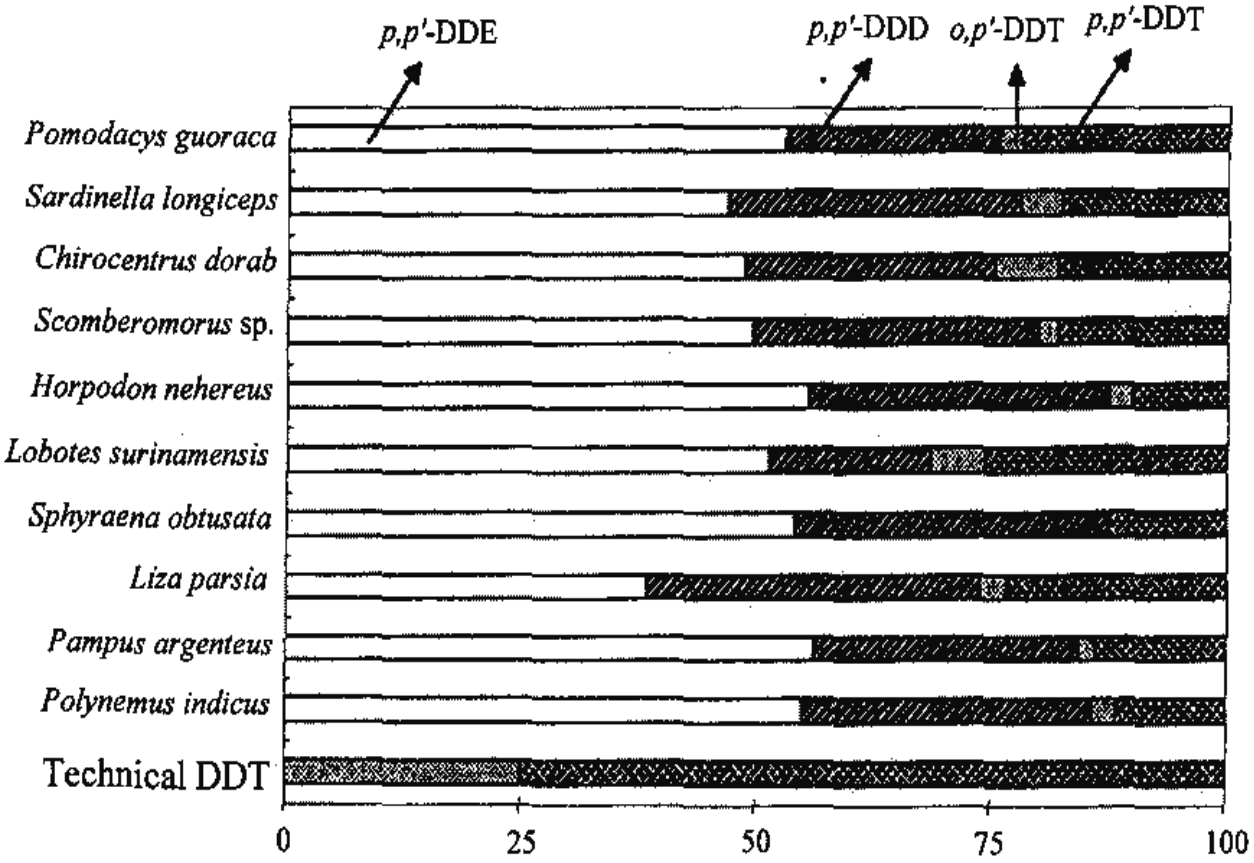

Figure 3. Percentage composition of DDT and its metabolites in the fishes collected from Dadar fish market.

The fish, *Lisa parsia*, is a herbivore, which had lower levels of HCH and DDT, (4.96 and 14.8 ng.g-1 respectively) in the muscle than the other fishes. (Shailaja and Sengupta,1989) recorded high level of DDT in the carnivorous fish *Pampus argenteus* (62.2 ng.g-1) but they failed to detect HCH isomers from the west coast of India, but observed trace in *Sardinella fimbriata* from the same area (Lat. 15^0 N; Long 73^0 E). (Shailaja and Singbal, 1994) reported a value of 9.95 ng.g-1 for DDT in bottom feeding carnivorous fish, *Polynemus indicus* from coastal Bay of Bengal, which are comparatively lower than the values of the present study (38.91 ng.g-1). The HCH and DDT values observed in the present study is an reasonable agreement with the reports made by (Ramesh *et al*., 1992) in several species of fish (0.48-14.0 ng.g-1 and 0.9-75 ng-g-1 respectively) from Parangipettai Coast (Lat. $11^0$30'N ; Long. $79^0$48'E). The total HCH value recorded in *Chirocentrus dorab* is comparable with the value recorded by (Karunagaran *et al*., 1994) from Kanniyakumari (Lat $8^0$04'N, Long.$77^0$36'E) coastal region (18.5 ng.g-1). No statistical analysis has been made, because the number of samples was very few. All the fishes in the present study show a significant positive relationship between their fat content and organochlorine concentrations. Of course, a fish cannot be considered as a fat globule in the aquatic environment accumulating fat-soluble compounds and bioaccumulation of pollutants by animals is a complicated process (Kannan *et al*., 1995)

(Erkmen and Kolankaya, 2006) have also observed the predominance of alpha and beta isomers of HCH in the fish samples of Meric delta (Turkey) The wide distribution of alpha HCH isomer in the fish samples may be explained as the gamma HCH can be easily degraded by micro organisms in soil and bottom sediments (Benezet and Matsumura, 1973) and photo chemically isomerised to the alpha isomer (Malaiyandi and Shah, 1984).

Linko *et al*. (1974) pointed out that the rate of bioaccumulation could differ depending on the lipid content of the fish. It may also depend on the feeding nature of the fish. Among HCH isomers, alpha HCH concentration was more followed by beta HCH because the percentage of alpha isomer is technical grade was more (70%). Moreover, the isomerisation of gamma HCH to alpha HCH could be the reason for this. The dominance of DDE in the total DDT burden in the tissue of the fish could be attributed to conversion of DDT to DDE or ingestion as it is. If it is the later it would mean that this area in the Arabian Sea in not threatened by new inputs of DDT. The estimated levels of HCHs and DDTs in edible fishes from Mumbai Coastal Region are well below the limits accepted by (5000 ng.g-1 Wet wt) as harmful to human health (FDA, 1977). The results of this study show that fish of the Dadar fish market in the Mumbai west coast of India are contaminated with various persistent OCPs. The low levels of OCPs can cause an increase in mixed function oxidase activity in fish (Fossi *et al*., 1986).

Conclusion

Pesticides have been recognized as serious pollution of aquatic environment. It affects fish directly by being accumulated in their body. They also cause serious impairment in metabolic, physiological and structural systems. The accumulation of pesticides in the tissues of a fish can result in chronic illness and cause potential damage of population. Fish are able to accumulate and retain pesticides and other pollutants from their environment. Accumulation of pesticides in the tissue of fish is dependent upon exposure concentration as well as other factors such as salinity, temperature, hardness and metabolism of fish.

Pesticides effect on specific vital organs such as liver, gill and kidney. Different degree of pesticides accumulation in various tissues depends upon the biochemical characteristic of pesticides. Fish may accumulate pesticides by absorption through gills, has been observed the concentration of pesticides in gill reflect the concentration of pesticides in water in which fish species live. The levels of most of the residues in fish were higher than those found in water.

The presence of contaminants, which are usually carcinogenic in nature, in fish of the west coast may pose serious health hazards to the local population. Because I did very little work has been carried out in the Dadar fish market at Mumbai west coast of India. More detailed investigations, in terms of sampling network and sampling frequencies are required in view of increasing global concern for persistent organic pollutants and their hazardous impact on environmental and human health.

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