

Study on Bioaccumulation of Lindane in Various Tissues of *Channa gachua* from Aurangabad District (MS) India

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Abstract: To study bioaccumulation level of lindane in various tissues of *Channa gachua*, been studied for the present study, fishes were collected from nearby agricultural area, has. Tissues like muscle, kidney and liver are used for quantification of bioaccumulation level of lindane. The tissues are blended with n-Hexane for extraction of pesticides and then were analyzed on Gas Chromatograph (GC, model, Chemito GC 7610). The concentration of lindane found at 0.1432 µg/g in kidney, 0.0361 µg/g in muscle and 0.1419 µg/g in liver. The accepted level in general of lindane in fish has been recorded is at 2.0 µg/g (on whole basis).

Key words: Bioaccumulation • Lindane • Gas Chromatograph • *Channa gachua*

INTRODUCTION

Pesticides are mostly non-selective, widespread applied, posses toxic properties and in some cases are very refractory. These features entitle pesticides to be one of the most fearful groups of substances, as far as biological communities and human beings are concerned. It include insecticides, acaricides, herbicides, fungicides and algaecides, indeed any chemical which is used to control of an unwanted organism (except bacteria), even rotenone which is used to kill unwanted fish. In the majority of cases, pesticides have the potential to cause damage to fish.

The most prominent pesticides in use is organochlorines, (eg. DDT, Lindane, Aldrin and Dieldrin), urectic derivatives (e.g. phenyl uretic derivatives, sulphonyl-ureatics and cyclic uracyl derivatives), triazines (e.g. Atrazin), carbamates and organophosphate compounds. Svobodova [1] have stated that, organochlorine pesticides act as nerve poisons and are highly toxic to fish (24-hour $LC_{50} < 1.0$ ml/L). Pesticides have been used in the public health sector for disease control and in agriculture to control and eradicate crop pest for the past several decades. Of these pesticides, especially, the organochlorines are very resistant to microbial degradation. They can therefore accumulate in human body fats and environment posing problem to human health [2].

Lindane is an organochlorine pesticide, which is under a great deal of regulatory pressure around the world. The usage of lindane has been banned in many countries of the world [3]. For example in Europe lindane use was reduced by two-thirds between 1970 and 1996 and was reduced outright for plant protection in some European countries. The state of California has banned lindane- based products in the treatment of lice and scabies. In Canada and other countries, lindane is generally not used to treat young children and has voluntarily been withdrawn from the market [4,5].

Lindane is a broad spectrum insecticide, which has been used since 1949 for agricultural and non agricultural purposes. Major agricultural use includes seed and soil treatment and wood and timber protection [6]. Lindane is also used against ectoparasites in veterinary and pharmaceutical products [7]. As a pharmaceutical preparation, lindane is an insecticide, larvicide and acaricides. It is used is topically in concentrations of 1 % for the treatment of scabies in some patients [8]. It is administered differently to treat pediculosis. It is also used for the control of disease vectors, including mosquitoes, lice and fleas [9].

Aquatic organisms can be used as biological indicator to monitor contamination of aquatic ecosystem with persistent aquatic contaminants (POPs) such as organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs). Because of their strong lipophilic

properties and their corresponding low solubility in water, it is much easier to determine POPs in the lipid fractions of aquatic organisms. The potential of fish as biomonitors is demonstrated by several monitoring studies [10-13]. Living organisms can get accumulate Chlorinated hydrocarbons from the surrounding media as well as from food. Intake via water predominates in aqueous organisms, whereas in terrestrial animals the main source is contaminated food. Pesticides can enter through water system directly through area treatments aimed at destroying the vegetation, algae and insects Froese *et. al.*, [14] or directly through the inflow of sewage and industry wastewater, through rainfall washing and leaching the surrounding contaminated soil, as well as through accidental or deliberate contamination. Aqueous flora accumulates pesticides in an attempt to eliminate them from the water, thus initiating the first step of bioaccumulation [15]. The grade of bioaccumulation can be expressed as a factor of bioaccumulation representing the ratio of a substance concentration in a living organisms and its concentration in the medium or food. In some fish, mollusks and insect species this ratio may reach a figure of several dozen or even thousands [16].

Fish acts as non-polar media that can adsorb hydrophobic organic chemicals within the water column. Since birds and humans consume fish, this makes fish good biomonitors for xenobiotic pollutants. The ingestion of foods contaminated with persistent lipophilic pesticides can result in accumulation of these pesticides in humans. The potential for pesticide residues to cross the placental barrier [17], even if it was in trace concentration, may cause serious damage in the newborns and therefore raises great concern. Organochlorine pesticides have already been implicated in a broad range of adverse human health and environmental effects, including reproductive failure and birth defects [18], immune system dysfunction, endocrine disruption and cancers [19,20].

Because these chemicals are toxic to living organisms, increased accumulation in the food chain may pose serious health hazards to the general populace [21]. The pesticides can cause toxic symptoms similar to those caused by dioxin exposure, including developmental abnormalities and growth suppression, disruption of the endocrine system, impairment of immune function and cancer promotion [22].

In order to avert any environmental and health disaster, it essential to put up mechanisms for monitoring of residues levels in the ecosystem as well as the food chain.

Because a large number of organic compounds are used today for the control of pests, weeds and diseases of plants, there is an increased need for the analysis of the residue products in the environment. To know concentration of these compounds in the environment requires special method of analysis.

In this respect, Gas Chromatography (GC) has become one of the most important method of analyzing pesticides and similar compounds. GC has got excellent resolution capability and high sensitivity using different detectors and columns.

MATERIALS AND METHODS

Sampling: The fish, *Channa gachua* were collected from Kham river, Aurangabad (MS) India, it is a tributary of Godavari River, India. Four sampling areas i.e. Spot 1, Spot 2, Spot 3 and Spot 4 were selected for the collection of the fishes. The fishes were collected during the month of May and June, 2008. All of the four selected spots were at high risk of industrial and urban run-off containing traces of pesticides. The fish were immediately brought to the laboratory in plastic containers and care was taken to avoid contamination during transport. The fish were killed and dissected out for taking tissues of different organs. The tissues selected for the study were body muscles, liver and kidneys.

Extraction of Lindane: The tissues were homogenized in small amount of water using warring blender and extracted by blending with 100 ml of 80 % acetonitrile in water in 1000 ml capacity separatory funnel. The mixture was further extracted three times using 50 ml portion of acetonitrile. The extracts were combined and washed with 500 ml Distilled water, 50 ml of saturated sodium chloride solution and 100 ml of n-hexane. The mixture was then allowed to stand for 30 minutes and the aqueous layer was drained into another 1000 ml capacity separatory funnel and then portioned with 50 ml n-hexane. The partitioning was repeated three times. All hexane portions were combined and through a plug of 10 gm sodium sulphate into a flask. The concentrated n- hexane was subjected to clean up using Conc. Sulphuric acid in 250 ml sized separatory funnel. The solvent was evaporated till 5 ml was left and that was analyzed on GC.

Quantification of Lindane: The estimation of the lindane was carried out by using gas chromatograph, (GC, Chemito 7610) equipped with flame ionization detector(FID) and electron capture detector (ECD, Ni-63) and the stainless steel column packed with 5% SE-30 having mesh size 80/100, length 8'

and diameter 1/8". The method was sensitive to 0.001 ppm for pesticides.

Operating Parameters:

Gas Flow:

Nitrogen 20 ml /min
(Carrier)
Nitrogen 25 ml /min
(Make up)

Temperature:

Oven temp 180°C
Injector temp 230°C
Detector temp 300°C

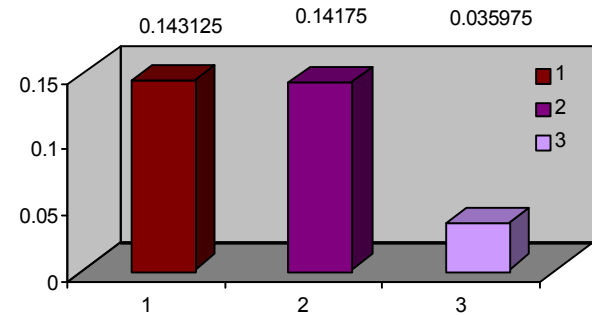
RESULTS

The values mentioned are mean values of the different spots.

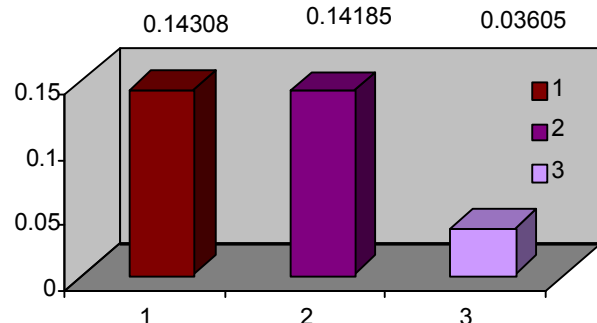
Lindane in Body Muscles: The Table 1 value shows that the concentration of lindane in fish muscles is at 0.0361 ug/g (on whole basis).

Lindane in Liver: Concentration of lindane in liver is found to be 0.1419 ug/g in liver.

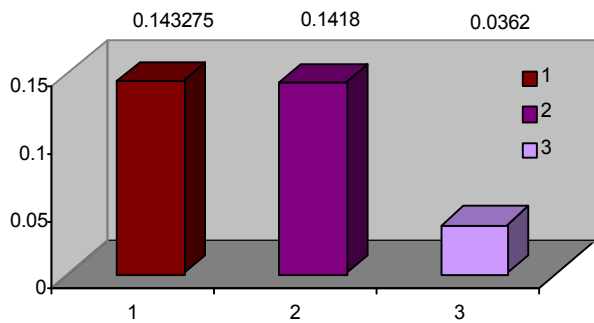
Lindane in Kidney: Lindane concentration in fish kidney is recorded at 0.1432 ug/g.



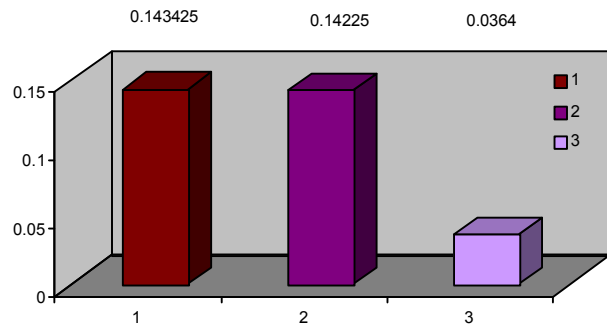
Sampling Spot 1:



Sampling Spot 2:



Sampling Spot 3:



Sampling Spot 4:

Fig. 1: The graphs showing levels of lindane concentration in various tissues at selected sampling spots

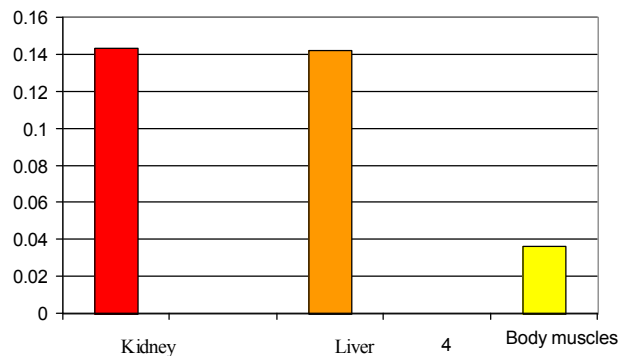


Fig. 2: Concentration of lindane in liver, kidney and body muscle (mean values taken)

Table 1: Concentration of lindane in various tissues of *C. gachua* at four selected spots

Sampling area	Concentration of lindane in tissue ($\mu\text{g g}^{-1}$)		
	Kidney	Liver	Body muscle
Spot 1 (n=4)	0.1431	0.1412	0.0361
	0.1432	0.1413	0.0360
	0.1431	0.1413	0.0359
	0.1431	0.1412	0.0359
	Mean = 0.143125	Mean = 0.14175	Mean = 0.035975
Spot 2 (n=4)	0.1431	0.1413	0.0361
	0.1431	0.1413	0.0361
	0.1430	0.1412	0.0359
	0.1431	0.1413	0.0361
	Mean = 0.14308	Mean = 0.14185	Mean = 0.03605
Spot 3 (n=4)	0.1433	0.1414	0.0362
	0.1432	0.1413	0.0362
	0.1433	0.1414	0.0361
	0.1433	0.1410	0.0363
	Mean = 0.143275	Mean = 0.1418	Mean = 0.0362
Spot 4 (n=4)	0.1434	0.1414	0.0364
	0.1435	0.1413	0.0365
	0.1435	0.1414	0.0363
	0.1433	0.1415	0.0364
	Mean = 0.143425	Mean = 0.14225	Mean = 0.0364
Mean	0.143226	0.141913	0.036156

DISCUSSION

From the above results it is clear that fishes collected from all the four spots show different values of bioaccumulation of lindane in their body muscles, liver and kidney. However the values are constant for particular type of tissue.

The higher lindane bioaccumulation in liver and kidneys as compared to body muscles can be correlated to the fact that, the lindane being lipophilic in nature gets more accumulated in the high lipid containing organs of body.

The levels of lindane residues are higher in kidney and liver are higher, this could be attributed to the pesticide being lipophilic; they reside and accumulate in fatty tissues. Pesticides enter fishes not only by ingestion but also through dermal absorption and respiration. When these chemicals are taken in by the fish, they bioaccumulate, biomagnify and remain in the fish till they are caught and consumed by man or eaten by bigger fishes which are eventually eaten by humans.

However the above levels of lindane in various tissues are far below the prescribed tolerance limits of pesticide residues under the Prevention of Food

Alteration Act, India [23]. According to this act the tolerance limit of lindane in food i.e. meat, poultry and fish is given to be 2.0 mg/kg (ppm).

In above case, though, the levels of lindane in body muscles is very low when compared to PFA Act, India there is need to monitor the levels of residue as it increases with time.

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