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Bioaccumulation of Chlorinated Pesticides in Muscle Tissue of Some Food Fishes from River Gomti, Lucknow

Ratnesh Kr. Singh

Department of Zoology, University of Lucknow, Lucknow, Uttar Pradesh, Pin code: 226007, India

ABSTRACT

Pesticides effluent is a powerful agent of ecological change in rivers, especially in India because major population depends on agriculture. Agriculture in India leads to increase the use of pesticides to full fill the food demand which results in contamination of the river Gomti [1]. Since pesticides are toxic chemicals, they unpropitious affect the non target organisms mainly fishes. The objective of present study was to find the level of persistent organochlorine pesticides (OCP) residue in food fishes of river Gomti. Indian major carps Rohu (*Labeo rohita*), Catla (*Catla catla)* and Mrigal (*Cirrhinus mrigala*) are found abundantly in our study area. Among 16 different OCPs tested, DDT and endosulfan were the most frequently detected OCPs.

Keywords: OCP, Pollution, Indian Carps, DDT, Endosulfan

INTRODUCTION

With the help of pesticides, crop production can be improvised but extra usage of pesticides is highly disastrous to aquatic ecosystem. Presence of pesticide residues in drinking water is a alarming call for human population. Animals and human of those cities, which are situated on the banks of any river or canals are severely prone to exposure of pesticides and may cause adverse effects on their health [2]. The ill effects of OCPs include neurologic deficits, cancer, especially non- Hodgkin's lymphoma and leukemia, developmental and reproductive impairment [3]. In India, largest pesticide consumption has been in the state of Uttar Pradesh, according to the data of 1995–1996 and 1999–2000, produced by Central Insecticide Board and Registration Committee, India [4]. Nationwide reports of groundwater contamination from pesticides have been documented.
There are 3 major groups of pesticides which are OCC (organochlorine compounds), OPC (organophosphorus compounds) and CC (carbamate compounds). OCC are highly diverse group of pesticide, in which DDT (dichloro diphenyl trichloroethane) and HCH (1,2,3,4,5,6 hexachlorocyclohexane) are major pesticides. Due to the long endurance of these chemicals in the environment, their residues through run off water from agricultural land enter the aquatic eco-system. Hence aquatic ecosystem is more sensitive to chlorinated pesticides pollution than terrestrial eco-system [5]. Being lipophilic in nature, pesticides are gradually accumulated at low concentrations in the body fat of mammals. Aggregation in fat might cause potential hazards in the body of those organisms [6]. Human breast and liver cancers, testicular tumors and lower sperm counts in many humans are reported due to

*Corresponding Author:
ratneshsingh1929[at]gmaildotcom

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OCPs [7]. The presence of contaminants in river, fishes may pose serious health hazards to the local population. Therefore, this study was undertaken to examine the levels and distribution patterns of some persistent OCPs in the fish samples of the Gomti River, India.

MATERIAL AND METHOD

The Gomti River, flowing through eight districts in Uttar Pradesh, covers an area of about 25,000 square km and traverses a total distance of about 730 km. Major carps of India that is Rohu (*Labeo rohita*), Catla (*Catla catla)* and Mrigal (*Cirrhinus mrigala*) are abundantly found in river Gomti. Samples were collected through January – June 2019 from location: Hanuman setu, Nishatganj Bridge, River front Gomtinagar and Daliganj Bridge. Fishes were washed with distilled water, once they brought to laboratory from their sampling sites. Analysis of Fish sample residue was done according to Tanabe et al [8]. Each fish was weighed (g) and the scales were removed. After that a small sample of muscle was cut (~ 10-12 gm). This muscle sample was homogenized with activated sodium sulfate. The mixture was extracted in soxhlet apparatus with the help of Whatman filter paper. In soxhlet apparatus n-hexane and dichloromethane are used in the ratio of 1:1 v/v for extraction. Extraction process takes approximately 6 hours. Extracts were gradually concentrated to make final volume 3-5 mL in a rotary vacuum evaporator. The final extract was purified on a glass column. Glass column was prepared with activated florisil and sodium sulfate. Concentrated extract was passes through glass column. The elution was performed in the presence of n-hexane (50mL) and 25% (v/v) dichloromethane. The eluate was concentrated to 3-4 mL and then was reduced finally to a volume of 1 mL. Agilent 6890 N Gas Chromatograph (GC) was used for analysis. This GC was fitted with Ni63 electron capture detector and HP-5 MS capillary [9].

Operational parameter of GC

Initially column temperature was set at 180ºC for 1 min, later than eventually increases at the rate of 3ºC/min to 230ºC for 5 minutes, afterwards at the rate of 10ºC/min to 265ºC for 10 min. Injector Temperature was 260ºC and split ratio was 1:10 [10]. Helium was used as carrier gas at the rate of 1 ml/min and make up with N_2 at the rate of 30 ml/min. The pesticides were identified and quantified based on the external standard (99.5%) solution of 16 different OC pesticides which are HCH (∝, β, γ and δ), DDD (op', pp'), DDE (op', pp'), DDT (op', pp'), endosulfan (∝, β, sulfate), aldrin, heptachlor and dicofol. Data analyzation were fulfill by one-way ANOVA method [11] and differences between the means of treatments were examined using least significance difference (LSD) [12].

RESULTS AND DISCUSSION

The p,p' DDE and o,p' DDD were mainly detected in most of the flesh samples, when 16 type of different OCPs were tested. Total DDT concentration comprising of individual isomers and metabolites in fish flesh was found in the range of 0.14-0.28 in Catla, 0.32-0.40 in Mrigal and 0.12-0.16 mg/kg in Rohu with mean concentration of 0.21 ± 0.07, 0.36 ± 0.04 and 0.14±0.02 mg/kg in Catla, Mrigal and Rohu respectively. Endosulfan (∝ β) in gills of Catla and Mrigal and ∝-HCH in gills of Catla were recorded. Total endosulfan concentrations in gills were 0.05 mg/kg and 0.22 mg/kg in Catla and Mrigal respectively (Table 2). In Table 1, DDT was detected in muscles of all 3 major carps, but Endosulfan was detected only in muscles of Mrigal. In Table 2, DDT was not detected in any species of Major Carps, but Endosulfan was found in the gills of two fish species which were Catla and Mrigal. Food Safety and Standard Authority of India (FSSAI) recommended the tolerance limit (TL) of DDT, DDE and DDD, for meat, poultry and fish is 7mg/Kg [13]. In present study, DDT concentrations in all the samples were below the tolerance limit and thus were safe for human consumption. The tolerance limit of endosulfan in fish,

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recommended by Food Safety and Standard Authority of India (FSSAI) is 0.20 mg/kg. So, in our study total endosulfan concentration (0.22 mg/kg) in gill of Mrigal was above the authorized limit, but in the gill of Catla and flesh of Mrigal endosulfan concentration was below the limit. The level of ∝-HCH (0.03 mg/kg) in gill of catla was below the tolerance limit of 0.25 mg/kg. After analyzing the results of present study, it clearly states that fishes of Gomti River are contaminated with several OCPs in prominent quantity. The low levels of OCPs can cause an increase in mixed function oxidase activity in fish [14]. More detailed investigations are need of hour in view of increasing global concern for persistent organic pollutants and their hazardous impact on environmental and human health.

Table 1: The Pesticide levels (mg/kg) in Muscles of Indian Major Carps

Pesticides	Pesticide concentration in muscles		
	C.catla	*C.mrigala*	*L.rohita*
DDT	0.21 ± 0.07	0.36 ± 0.04	0.14±0.02
Endosulfan	ND	0.05	ND

Table 2: The Pesticide levels (mg/kg) in Gills of Indian Major Carps

Pesticides	Pesticide concentration in gills		
	C.catla	*C.mrigala*	*L.rohita*
DDT	ND	ND	ND
Endosulfan	0.05	0.22	ND
HCH	0.03	ND	ND

ND – Not Detected

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