Asian Journal of Chemistry; Vol. 28, No. 3 (2016), 601-606

ASIAN JOURNAL OF CHEMISTRY

http://dx.doi.org/10.14233/ajchem.2016.19428

Levels of Organochlorine and Organophosphorus Pesticide Residues in Water and Soil of Musi River Belt Area Hyderabad, India

KOTINAGU KORRAPATI* and KRISHNAIAH NELAPATI

Department of Veterinary Public Health and Epidemiology, College of Veterinary Science, Rajendranagar, Hyderabad-500 030, India

*Corresponding author: E-mail: kotinagu@gmail.com

Received: 20 June 2015; *Accepted*: 3 August 2015; *Published online*: 5 December 2015; AJC-17659

A study was conducted to estimate residues of certain pesticides of organochlorines *viz*., dichlorodiphenyltrichloroethane (*e.g.*, *o,p'*-dichlorodiphenyldichloroethylene, *o,p'*-dichlorodiphenyldichloroethane, *p,p'*-dichlorodiphenyltrichloroethane and *o,p'*-dichlorodiphenyltrichloroethane), dicofol, α-, β-, γ-, δ-hexachlorocyclohexane, cyclodiene compounds (aldrin, endosulfan sulphate and heptachlor) and organophosphates (dichlorovas, phorate, dimetheoate, methyl-chlorpyrifos, methyl-parathion, fenitrothion, chlorpyrifos, quinolphos, profenophos, ethion and phosalone) in water and soil samples collected from six zones of Musi river belt area Hyderabad, to evaluate the pollution level of Musi river. The river belt was divided in to six zones. Organophosphorus pesticide residues quinolphos was found in water and soil samples collected from zone 2, 3, 4 and 5, Ethion residues were found in water and soil samples collected from zone 2, 3, 4 and 6. Whereas soil samples collected from zone 1 showed residues of *p,p'*-dichlorodiphenyldichloroethylene, *o,p'*-dichlorodiphenyldichloroethane, *p,p'*-dichlorodiphenyltrichloroethane, *o,p'*-dichlorodiphenyltrichloroethane, total dichlorodiphenyltrichloroethane and δ hexachlorocyclohexane. The residues of all other organochlorine, cyclodienes and organophosphorus pesticides were below detection level in the water and soil samples collected from all six zones.

Keywords: Soil, Gas chromatography, Water, Musi river, Pesticide residues.

INTRODUCTION

Environment pollution is one of the serious predications of the modern world [1]. During the last decade, due to the significant increases in the environmental pollutants and lack of precautionary measures or observance of the environmental regulation, it has become a global problem [2]. The ever-increasing trend of population growth and the higher rate of food consumption have forced the producers to intensify their efforts to increase food products. Although most of the pesticides leave the products or degrade in soil, water and atmosphere, some trace amounts of pesticides can be transferred to humans *via* the food chain, being potentially harmful to human health [3].

Pesticides are divided into number of classes, of which the important are organochlorine and organophosphorus compounds. Among the two main classes, organochlorine pesticides resist biodegradation and they can be concentrated through food chains and produce a significant magnification of the original concentration at the end of the chain. Due to this residence time of these substances in the environment, there is a great interest in examining the pollution they cause. On the other hand, organophosphorus pesticides are known to degrade rapidly depending on their formulation, method of application, climate and the growing stage of the plant. Developed countries have banned many of the older pesticides due to potential toxic effect to human or their impact on eco-systems. Oraganochlorine pesticides are low-cost to produce in developing countries and remain highly effective for some purposes. Developing countries prepare these compounds as they cannot afford high cost even though impact is there on ecology. The farmers as one of the main components of this chain are also using escalating amounts of pesticides to protect their crops [4,5] and control of domestic pests. Although these chemicals facilitate the anthropogenic land use, they usually pose danger to the biotic species and seriously damage the human living environment [6,7].

Musi river is located on the Deccan platue in the state of Andhra Pradesh, India. Originates 60 KMs upstream of Hyderabad city and finally enters Krishna river 200 KMs downstream of it. Earlier two reservoirs (Osman sagar and Himayat sagar) were created upstream of Musi river to supply drinking water. Musi river supplied irrigation water for cultivation of crops and fodder. However, now the water is highly polluted as 600 million liters per day of untreated sewage water is discharged into Musi river, additionally 14

industrial estates drain their untreated effluents into this river. The agricultural drained water is another source of pollution and this river water is rich in heavy metals, pesticide residues, phenols, oils, grease, alkalis and acids [8].

The self purifying property of river water is unable to clear the pollution and the polluted water poses serious risk to public health especially in areas where river water is used for irrigation. As the population of Hyderabad is increasing, causing an increase in the amount of untreated waste and poor implementation of Musi river purification programs is increasing the pollutants in river water. Irrigation of this polluted water causing water and soil contamination. Keeping this in view of the Musi river pollution and its direct or indirect effect on environment, animal and human system a study was conducted to analyze the water and soil samples on the banks of river Musi for the presence of pesticide residues. The study has been conducted in the year 2013 on river Musi, located in Andhra Pradesh, India.

EXPERIMENTAL

Based on the pollution levels through the downstream of Musi river, the area was divided in to six zones for collection of samples (Fig. 1). This study was based on 48 water samples and 48 soil samples collected from six divided zones (8 from each zone) (Table-1). Sterilized glass bottles were used to collect 1000 mL of water from the downstream of Musi river, labeled and transported in Ice pack. Sterilized polyethene packs were used to collect 250 g of soil from the lands in the eight specified areas of each zone after digging 15 cms, packed and transported to the lab. Both soil and water samples were brought to All India Network Project on Pesticide Residues, Acharya N.G. Ranga Agricultural University, Hyderabad, India and processed immediately or stored at -20 °C until analysis. The estimation of pesticides was carried out by gas chromatography equipped with electron capture detector and pulsated flame photo metric detector. Prior to the sample analysis, the

TABLE-1
SELECTED ZONES AND COVERED AREAS ALONG THE MUSI RIVER BELT, TELANGANA, INDIA

Zone	Areas covered along Musi river belt
1	Attapur, Langer House, Upper pally, KishanBagh, Bahadurpura, Puranapool, Budvel, High court
2	Chadharghat, Malakpet, Morarambagh, Golnaka, Amberpet, Ramanthapur, Nagole, Uppal
3	Peerzadiguda, K. singaram, Thimaiguda, Pratapasingaram, Korremulla, Bacharam, Bandaraviral, Chinnaraviralla
4	PillaiPalli, Rudravelly, Brahmanapally, Venkiryala, Edulabad, NadamaKhada, Shivareddygudem, Alinagar
5	Indriyala, D.R.palli, Wankamamidi, Shaligowraram, Dharmaram, Chittur, Jajireddygudem, Manimadde
6	Musi reservoir, Yendlapally, Kasarabad, Beemavaram, Dasaphad, M.gudem, Irkigudem, Wazirabad

residues analysis method was validated following the principles of SANCO document (12495/2011). The collected water samples were sieved and taken into 50 mL centrifuge tube, for soil samples stacks are removed, samples were sieved, homogenized and dried at room temperature and 10 g of sample was taken into 50 mL centrifuge tube. The required quantity of (organochlorine and organophosphorus) intermediary standards prepared from certified reference material is added to each 15 g samples of both water and soil to get fortification levels of 0.05 and 0.1 ppm in three replications each. The AOAC official method 2007.01 with slight modifications was validated for estimation of limit of quantification of organochlorine pesticides (OCPs) and organophosphorus pesticides (OPPs) in water and soil samples.

For extraction from soil and water samples QuEChERs method was followed. A 750 mL of water sample was taken in sapatatory funnel, 150 g of sodium chloride is added and shaken till it dissolved completely and 100 mL of dichloromethane was added, vigorously shaked for 1 min by releasing pressure intermittently (Step-1), let the layers separated (Step-2), lower layer (organic phase) was collected by passing through anhydrous sodium sulphate bed in 500 mL conical flask (Step-3). Then

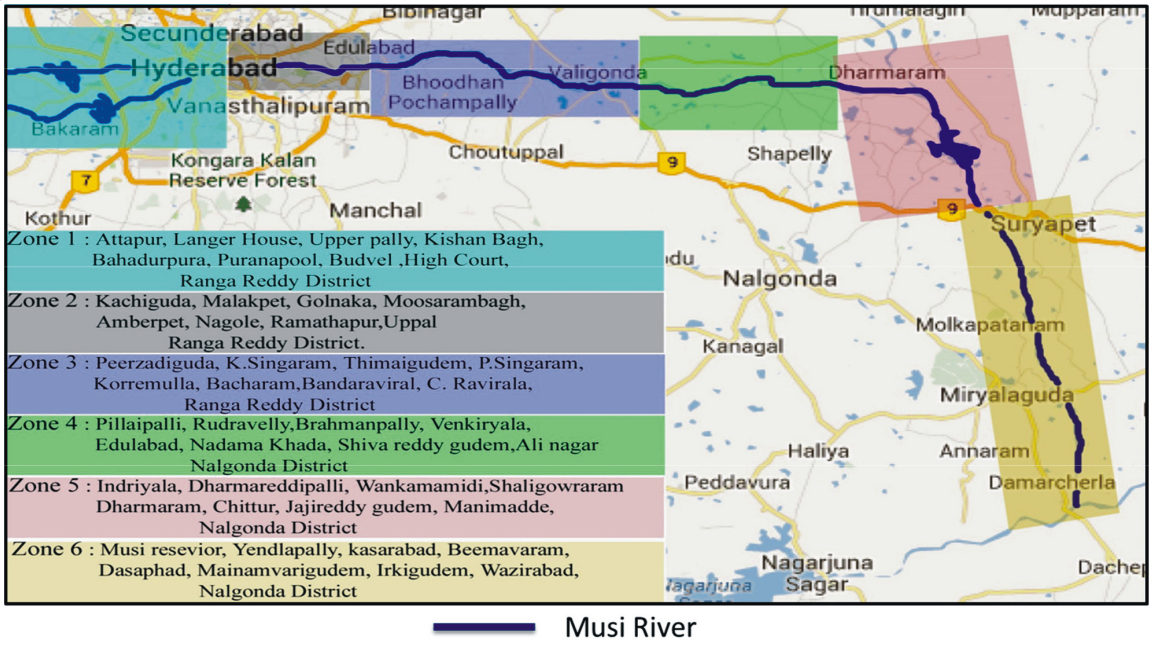

Fig. 1. Research zones along Musi river belt

50 mL of dichloromrthane was added to the upper organic layer and steps 1, 2 and 3 were repeated. Lower layer (oragnic phase) was collected and evaporated in rotator evaporator till dryness or extract was washed with 15 mL hexane for 3 times and final volume of 1 mL was made up with acetone:hexane (1:9 v/v).

For soil samples of 10 g were taken into a beaker and 20 mL of acetonitrile was added and vigorously shaken to mix well and 4 g of $MgSO_4$ and 1 g of NaCl were added. From that 10 mL of supernatant was taken in 15 mL of tube containing 250 mg PSA and 1.5 rams $MgSO_4$, sonicated for 1 min then it is centrifuged for 10 min at 4400 rpm and 4 mL of supernatant was collected and evaporated to near dryness, residues were reconstituted to 1 mL with cyclohexane.

A Shimadzu 2010 gas chromatography equipped with a VF-1MS capillary column and with electron capture detector and flame photometric detector. All the chemicals were purchased from M/s Merck specialties Pvt. Limited and were pesticide residue grade and all the pesticide residue standards were purchased from Dr. Erhenstorfer, Germany during 2012. The gas chromatographic analysis was performed under the following conditions (Table-2). 1 mL sample was injected into the gas chromatography; peaks were identified by comparing their retention times (Table-3) with those of standards under the same injection conditions. The peak areas of the various peaks whose retention times coincide with the standards were extracted on their corresponding calibration curves to obtain the concentrations.

RESULTS AND DISCUSSION

Water and soil samples, 48 each were collected from 6 zones of Musi river belt and were analyzed for organochlorine pesticides and organophosphorus pesticides residues. Concentrations of various residues in each sample were calculated (in mg/kg sample). In the present study, the average recoveries of organochlorine pesticides in water were from 88.05 % at 0.05 ppm and 86.71 % at 0.1 ppm and in soil were from 88.45 % at 0.05 ppm and 91.25 % at 0.1 ppm. Average recoveries of organophosphorus pesticides in water were 91.27 % at 0.05 ppm and 94.67 % at 0.1 ppm and in soil were from 91.25 % at 0.05 ppm and 86.77 % at 0.1 ppm. The efficiency of extraction methodologies were evaluated based on the recoveries of residues and a recovery of 75-102 % is considered as acceptable [9]. Hence, the extraction procedures employed in these experiments were efficient in recovering the maximum amount of residues present in the samples.The elute pattern of various organochlorine pesticides (0.01 ppm) and organophosphorus pesticides (0.05 ppm) along with specific retention time are depicted in Table-3 for electron capture detector and for pulsated flame photometric detector (PFPD). The limit of detection and limit of quantitation for organochlorine pesticides was 0.01 ppm and 0.05 ppm, respectively and for organophosphorus pesticides was 0.05 ppm and 0.05 ppm, respectively for both electron capture detector and pulsated flame photometric detector.

Organochlorine pesticide compounds *p,p'*-dichlorodiphenyldichloroethylene, *o,p'*-dichlorodiphenyldichloroethane, *p,p'*-dichlorodiphenyltrichloroethane, *o,p'*-dichlorodiphenyltrichloroethane, total dichlorodiphenyltrichloroethane, dicofol, α-hexachlorocyclohexane, β-hexachlorocyclohexane, γ-hexachlorocyclohexane, δ-hexachlorocyclohexane, cyclodiene compounds aldrin, endosuphansulphate, heptachlor and organophosphates (dichlorovas, phorate, dimetheoate, methyl-chlorpyrifos, methyl-parathion, fenitrothion, chlorpyrifos, profenophos and phosalone) could not be detected in water samples from all the six zones of Musi river belt. Whereas quinolphos (Table-4) residues found in the water samples collected from zone 2, 3, 4 and 5 at a concentration of 2.55,

TABLE-2
DETAILS OF GC OPERATING PARAMETERS

Gas chromatograph	Gas Chromatography-Shimadzu 2010
Column	VF-1ms Capillary column 30 m length, 0.25 mm Internal Diameter, 0.25 mm film thickness; 1 % methyl siloxane
Column oven (°C)	260 (Isothermal)
Detectors	Electron capture detector (ECD) Flame photometric detector (FPD)
Detector temperature (°C)	280
Injector temperature (°C)	260
Injector status	Front injector type 1177 Split/Splitless Split ratio: 1:5
Carrier gas	Nitrogen, Iolar II, Purity 99.99 %
Carrier gas flow (mL min^{-1})	1
Make-up flow (mL min^{-1})	35
Total run time (min)	60

TABLE-3
RETENTION TIMES OF ORGANOCHLORINE PESTICIDES AND ORGANOPHOSPHORUS PESTICIDES SPIKED ON ELECTRON CAPTURE DETECTOR (ECD) AND PULSATED FLAME PHOTOMETRIC DETECTOR (PFPD)

Retention time	Electron capture detector
4,4-Dichlorodiphenyldichloroethylene	27.171
2,4-Dichlorodiphenyldichloroethane	28.539
4,4-Dichlorodiphenyltrichloroethane	31.312
2,4-Dichlorodiphenyltrichloroethane	29.081
α-Hexachlorocyclohexane	14.434
β-Hexachlorocyclohexane	18.006
γ-Hexachlorocyclohexane	16.177
δ-Hexachlorocyclohexane	19.366
Aldrin	22.026
Endo sulfate	33.090
Heptachlor	19.704
Dicofol	24.082

Retention time	Electron capture detector	Pulsated flame photometric detector
Dichlorovas	3.947	3.889
Phorate	13.523	13.427
Dimethoate	15.300	15.196
Chlorpyriphos-Methyl	19.074	18.925
Methyl parathion	20.249	20.090
Fenitrothion	–	21.726
Chlorpyriphos	22.278	22.111
Quinolphos	26.775	26.587
Profenphos	30.796	30.606
Ethion	34.634	34.436
Triazophos	–	37.406
Phosalone	47.747	47.511
λ-Cyhalothrin	48.497	–

1.93, 0.14 and 0.22 ppm, respectively and ethion residues were at concentration of 0.16, 0.18, 0.16 and 0.1ppm in zone 2,3,4 and 6, respectively. Reddy *et al.* [10] could not detect ethion in water samples collected from both Husain Sagar lake and Mir Alam lake in Hyderabad. A residue levels of *p,p'*-dichlorodiphenyldichloroethylene of 0.046 ppm and 11.29 ng/mL were reported by Mutiyar *et al.* [11] and Samoh and Ibrahim [12], respectively. Mutiyar *et al.* [11] reported 0.024 ppm of *o,p'*-dichlorodiphenyldichloroethane residues in water sample. Leena *et al.* [13] and Shah & Patel [14] could not detect *p,p'*-dichlorodiphenyltrichloroethane in water samples. A residue level of 0.087-1.133 μg L^{-1} *p,p'*-dichlorodiphenyltrichloroethane was reported by Reddy *et al.* [10] in water samples from Hussainsagar lake, Hyderbad. Leena *et al.* [13] and Shah *et al.* [14] reported the residues of *o,p'*-dichlorodiphenyltrichloroethane in water samples of 78.22 and 78.20 ng L^{-1}, respectively. But in the present study none of the water samples from the six zones of Musi river belt shown the residues of *o,p'*-dichlorodiphenyltrichloroethane. Dicofol was not detected by Reddy*et al.* [10] in the water samples collected from Hussain sagar and Mir Alam lake, Hyderabad.

A residue levels of 0.004 ppm and 0.004 μg L^{-1} of α-hexachlorocyclohexane were reported by Mutiyar *et al.* [11] and Bulut *et al.* [15], respectively in water samples. A residue levels of β-hexachlorocyclohexane of 0.009 and 0.131 ppm were reported by Mutiyar *et al.* [11] and Bulut *et al.* [15], respectively where as Reddy *et al.* [10] reported a range of 0.823-2.348 μg L^{-1} and ND-1.066 μg L^{-1} in water samples taken from Hussain sagar lake and Mir Alam lake, Hyderbad, respectively. Reddy *et al.* [16] and Mutiyar *et al.* [11] reported that the residual concentration of γ-hexachlorocyclohexane in water sample were 0.011 ppm and 0.012 ppm, respectively. A prevalence of 56 % of γ-hexachlorocyclohexane in water sample was reported by Ahmad *et al.* [17], but none of the water sample in the present study reported the residues of γ-hexachlorocyclohexane. Reddy *et al.* [10] reported the values of 0.721-4.213 μg L^{-1} and 0.080-0.170 μg L^{-1} δ-hexachlorocyclohexane in the water samples of Hussain sagar lake and Mir Alam lake, respectively, Bulut *et al.* [15] and Mutiyar *et al.* [11] reported a residual concentration of 0.045 μg L^{-1} and 0.014 ppm of δ-hexachlorocyclohexane, respectively. The total hexachloro-cyclohexane was not detected in the present study in water samples whereas concentration of 0.811 ppm was reported by Krishnamurthi [18].

Endosulphansulphate residues were not detected in water samples in the present study and the similar results were reported by Upadhi and Wokoma [19] in surface water in delta of Nigeria. A residue levels of endosulphansulphate of 0.004 ppm, 0.009 ppm, 0.004 ppb and 0.039 ppm in water samples was reported by Rangarao *et al.* [20], Aulakh [21], Amaraneni [22] and Mutiyar *et al.* [11], respectively. Similarly, Reddy *et al.* [10] also did not find heptachlor in water samples collected from Hussain Sagar and Miralam lakes of Hyderabad. A residue levels of 0.025 ppm and 0.032 ppm of heptachlor was reported by Pujeri *et al.* [23] and Mutiyar *et al.* [11], respectively. Malhat and Nasr [24] and Fagnani *et al.* [25] also did not found any residues of dimethoate in water as in the present study whereas residual levels of 0.11 and 1.00 in water samples were reported by Ahad and Hayat [26] and Kanda *et al.* [27], respectively. No residues of chlorpyrifos were detected in the present study and similar results were reported by Malhat and Nasr [24] in water samples collected from Nile river, Egypt.

A residual levels of chlorpyriphos (0.012 ppm) was reported by Rangarao and Sahrawat [20] whereas Reddy *et al.* [10] reported levels of 3.123 and 0.734 μg L^{-1}, respectively from Hussainsagar and Mir Alam lakes. No residues of methyl chlorpyriphos in the present study was detected and the similar results were reported by Malahat and Nasr [24] in water samples collected from Nile river tributaries, Egypt. A residual levels of 0.017 ppm and 0.068 ppm were reported by Ramadan *et al.* [28] and Mutiyar *et al.* [11] in water samples.

Forty eight soil samples were also analyzed for the same organochlorine pesticides, cyclodienes and organophosphorus pesticides as done for the water samples. The residues of *p,p'*-dichlorodiphenyldichloroethylene, *o,p'*-dichlorodiphenyldichloroethane, *p,p'*-dichlorodiphenyltrichloroethane, *o,p'*-dichlorodiphenyltrichloroethane and total dichlorodiphenyltrichloroethane was noticed only in soil samples collected from zone 1 area (Table-4) and the mean value were 0.06, 0.73, 1.27, 0.14 and 0.55 (ppm), respectively. Lower levels of *p,p'*-dichlorodiphenyldichloroethylene of 18.8 ng g^{-1} in soil sample were reported by Gong *et al.* [29] than the present study (0.06 ppm). Lower levels were reported by Gong *et al.* [29] for *o,p'*-dichlorodiphenyldichloroethane of 1.3 ng g^{-1} than the present study (0.73 ppm). A higher residual concentration of *p,p'*-dichlorodiphenyltrichloroethane of 7.16 ppm in soil samples was reported by Musa *et al.* [30] and lower residual concentration of 8.85 and 27.5 ng g^{-1} were reported by Leena *et al.* [13] and Gong *et al.* [29], respectively than the present study (1.27 ppm). A residue levels of *o,p'*-dichlorodiphenyltrichloroethane of 0.9 and 29.60 ng g^{-1} were reported by Gong *et al.* [29] and Leena *et al.* [13], respectively which are lesser than the present study (0.14 ppm). Low residue levels of total dichlorodiphenyltrichloroethane of 0.001 to 0.066 ppm in soil sample than the present study (0.0603 to 1.2795 ppm) was reported by Kumari *et al.* [31], whereas higher levels (0.472-7.27 ppm) were reported by Saxena *et al.* [32]. The presence of dichlorodiphenyltrichloroethane in high concentration might be attributed to slow degradation of dichlorodiphenyltrichloroethane resulting in environmental persistence [33]. Nishin *et al.* [34] reported that the residual levels of dicofol in soil sample collected from Red river delta, northern Vietnam were below the maximum allowable concentration by Vietnamese Government.

Residual values of α-hexachlorocyclohexane of 0.10 ppm and 1.81 ppm were reported by Prakash *et al.* [35] in soil samples of Takari area of Delhi and Musa *et al.* [30] in the soil samples of Yala Basin in Japan, respectively. A residual level of 0.92 ppm, 6.80 ppm and 3 ppb of β-hexachlorocyclohexane in soil samples were reported by Musa *et al.* [30] from Yala Basin, Japan during Rainy season, Prakash *et al.* [35] from Nagal, Delhi and Kathpal *et al.* [36], respectively. A residue levels of 0.08 ppm and 6.43 ppm of γ-hexachlorocyclohexane in soil samples were reported by Prakash *et al.* [35] and Musa *et al.* [30], respectively.

A residual level of 0.08 ppm of δ-hexachlorocyclohexane (Table-4) was found in soil samples of zone 1 area in the present study, slightly lower than the value reported by Prakash *et al.* [35]. Lower residue levels of total hexachlorocyclohexane of

TABLE-4
MEAN RESIDUAL LEVELS (ppm) OF ORGANOCHLORINE AND ORGANOPHOSPHORUS PESTICIDES IN WATER AND SOIL SAMPLES

Pesticides/Zones		4,4-DDE	2,4-DDD	4,4-DDT	2,4-DDT	α-HCH	β-HCH	γ-HCH	δ-HCH	Aldrin	Heptachlor	Dicofol
Water	Zone I	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone II	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone III	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone IV	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone V	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone VI	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Soil	Zone I	0.06 ± 0.005	0.73 ± 0.01	1.27 ± 0.09	0.14 ± 0.015	BDL	BDL	BDL	0.08 ± 0.003	BDL	BDL	BDL
	Zone II	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone III	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone IV	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone V	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone VI	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Pesticides/Zones		Phorate	Dimethoate	Chlorpyriphos-Methyl	Methyl parathion	Fenitro-thion	Chlorp-yriphos	Quinolphos	Profenphos	Ethion	Triazophos	Phosalone	λ-Cyhalothrin
Water	Zone I	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
	Zone II	BDL	BDL	BDL	BDL	BDL	BDL	2.55 ± 0.006	BDL	0.164 ± 0.007	BDL	BDL	BDL
	Zone III	BDL	BDL	BDL	BDL	BDL	BDL	1.93 ± 0.004	BDL	0.18 ± 0.01	BDL	BDL	BDL
	Zone IV	BDL	BDL	BDL	BDL	BDL	BDL	0.14 ± 0.01	BDL	0.16 ± 0.02	BDL	BDL	BDL
	Zone V	BDL	BDL	BDL	BDL	BDL	BDL	0.22 ± 0.005	BDL	BDL	BDL	BDL	BDL
	Zone VI	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.1 ± 0.04	BDL	BDL	BDL
Soil	Zone I	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.08 ± 0.003	BDL	BDL	BDL	BDL
	Zone II	BDL	BDL	BDL	BDL	BDL	BDL	1.56 ± 0.01	BDL	0.3 ± 0.003	BDL	BDL	BDL
	Zone III	BDL	BDL	BDL	BDL	BDL	BDL	0.33 ± 0.009	BDL	0.05 ± 0.002	BDL	BDL	BDL
	Zone IV	BDL	BDL	BDL	BDL	BDL	BDL	2.31 ± 0.001	BDL	0.13 ± 0.15	BDL	BDL	BDL
	Zone V	BDL	BDL	BDL	BDL	BDL	BDL	0.17 ± 0.01	BDL	BDL	BDL	BDL	BDL
	Zone VI	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.03 ± 0.007	BDL	BDL	BDL

DDE = Dichlorodiphenyldichloroethylene; DDD = Dichlorodiphenyldichloroethane; DDT = Dichlorodiphenyltrichloroethane; HCH = hexachlorocyclohexane
BDL = Below determination level (< 0.01); (Each value is mean of 8 replications)
Zone I = Attapur, Langer House, Upper pally, KishanBagh, Bahadurpura, Puranapool, Budvel, High court.
Zone II = Chadharghat,Malakpet,Morarambagh, Golnaka, Amberpet, Ramanthapur, Nagole, Uppal.
Zone III = Peerzadiguda, K.singaram, Thimaiguda, Pratapasingaram, Korremulla, Bacharam, Bandaraviral, Chinnaraviralla.
Zone IV = PillaiPalli, Rudravelly, Brahmanapally, Venkiryala, Edulabad, NadamaKhada, Shivareddygudem, Alinagar.
Zone V = Indriyala, D.R.palli, Wankamamidi, Shaligowraram, Dharmaram, Chittur, Jajireddygudem, Manimadde.
Zone VI = Musi reservoir, Yendlapally, Kasarabad, Beemavaram,Dasaphad, M.gudem, Irkigudem, Wazirabad.

0.002 to 0.051 ppm in soil sample than the present study (0.0654 to 0.0984 ppm) was reported by Kumari *et al.* [31], whereas still lower levels (3 ppb) was reported by Kathpal [36].

Residue level of 2 ppb and 12.67 ppm of aldrin were repoted by Kathpal *et al.* [36] and Musa *et al.* [30], respectively in the soils samples. Residue levels of endosulphansulphate of 0.039 ppm, 0.426 ppm, 0.12 ppb and 0.01 ppb in soil samples were reported by Kumari *et al.* [31], Anwar *et al.* [37], Leena *et al.* [13] and Upadhi *et al.* [19], respectively. Musa *et al.* [30] reported the residual levels of 9.58 ppm of Heptochlor in soil samples at Yala basin of Japan whereas it was not present in the present study.

The mean residue levels of 1.56, 0.33, 2.31 and 0.17 (ppm) of quinolphos were present in soil samples collected from zone 2, 3, 4 and 5, respectively, whereas mean residual levels of 0.3, 0.05,0.13 and 0.03 (ppm) of ethion (Table-4) were seen in zone 2,3,4 and 6, respectively. Anwar *et al.* [37] reported the mean residual concentration of chlorpyrifos in soil samples collected from Nawabshah district, Sindh, Pakistan was 0.0486 ppm. Musa *et al.* [30] reported the residual levels of methyl-chlorpyrifos in soil sample was 14.78 ppm. Except the residues of *p,p'*-dichlorodiphenyldichloroethylene, *o,p'*-dichlorodiphenyldichloroethane, *p,p'*-dichlorodiphenyltrichloroethane, *o,p'*-dichlorodiphenyltrichloroethane, δ-hexachlorocyclohexane, quinolphos and ethionin soil samples all other organochlorine pesticides, organophosphorus pesticides and cyclodiene compounds were below detection level in the present study.

Conclusion

From this study, it can be concluded that soil samples collected from zone 1 area contain isomers of dichlorodiphenyltrichloroethane, δ-hexachlorocyclohexane, because the dumping yard of Greater Hyderabad Municipal corporation (GHMC) located near the High court (zone 1) and Osmania general hospital is also located in this area where dichlorodiphenyltrichloroethane is commonly used as insecticide to control mosquito menace, this might have contributed for these residues. Water and soil samples collected from zone 2, 3, 4 and 5 shown the residues of quinolphos whereas water and soil samples collected from zone 2, 3, 4 and 6 shown the residues of ethion. The organophosphorus pesticides were used as insecticide for rice and vegetables grown on the catchment areas of Musi river belt might have been contributed for these residues. However, the results of organophosphorus pesticides in different samples were detected by electron capture detector and confirmed by pulsated flame photometric detector, whereas organochlorine pesticides were detected by only electron capture detector. Owing to effects on human, animal and environmental health of pesticide residues need for education and awareness among farmers about extensive use of pesticide was envisaged.

ACKNOWLEDGEMENTS

The authors are grateful to the College of Veterinary Science, Sri Venkateshwara Veterinary University, Hyderabad, India for the financial support and also thankful to the administrative authorities of All India network project on pesticide residues, Acharya N.G. Ranga Agricultural University, Hyderabad, India for their laboratory support and encouragement.

REFERENCES

1. D.G. Hela, D.A. Lambropoulou, I.K. Konstantinou and T.A. Albanis, *Environ. Toxicol. Chem.*, **24**, 1548 (2005).
2. K.Y. Abdel-Halim, A.K. Salama, E.N. El-khateeb and N.M. Bakry, *Chemosphere*, **63**, 1491 (2006).
3. C.M. Benbrook, *J. Epidemiol. Community Health*, **56**, 822 (2002).
4. H. Okamura, M. Piao, I. Aoyama, M. Sudo, T. Okubo and M. Nakamura, *Environ. Pollut.*, **117**, 411 (2002).
5. J. Struger, Pesticide Concentration in the Don and Number River Watersheds, Environment Canada, pp. 1-3 (2002).
6. M. Sudo, T. Kunimatsu and T. Okubo, *Water Res.*, **36**, 315 (2002).
7. T. Na, Z. Fang, G. Zhanqi, Z. Ming and S. Cheng, *Environ. Monit. Assess.*, **123**, 351 (2006).
8. P. Cheepi, *Int. Res. J. Social Sci.*, **2**, 18 (2013).
9. E. Majzik-Solymos, A. Visi, G. Karoly, B. Beke-Berczi and L. Gyorfi, *J. Chromatogr. Sci.*, **39**, 325 (2001).
10. N.K. Reddy, M. Aruna and S. Satyanarayana, *J. Chem. Biol. Phys. Sci.*, **2**, 505 (2012).
11. P.K. Mutiyar, A.K. Mittal and A. Pekdeger, *Drink.Water Eng. Sci.*, **4**, 51 (2011).
12. A.N.H. Samoh and M.S. Ibrahim, *Environ. Asia*, **2**, 30 (2009).
13. S. Leena, S.K. Choudhary and P.K. Singh, *Int. J. Environ. Sci.,* **3**, 1 (2012).
14. P.G. Shah, B.K. Patel, M.E Raj and R.D. Patanwadia, *Pesticide Res. J.*, **4**, 117 (1992).
15. S. Bulut, S.F. Erdogmus, M. Konuk and M. Cemek, *Ekoloji*, **74**, 24 (2010).
16. D.J. Reddy, B.N. Rao, K.N. Reddy, M.A. Sultan and T.R. Babu, *Pesticide Res. J.*, **9**, 97 (1997).
17. S. Ahmad, M. Ajmal and A.A. Nomani, *Bull. Environ. Contam. Toxicol.*, **57**, 794 (1996).
18. V.V. Krishnamurthi, *Pestology*, **23**, 34 (1999).
19. F. Upadhi and O.A.F. Wokoma, *Res. J. Environ. Earth Sci.*, **411**, 939 (2012).
20. G.V. Rangarao and K.L. Sahrawat, *Indian J. Dryland Agric. Res. Dev.*, **24**, 21 (2009).
21. R.S. Aulakh, Ph.D. Dissertation, Studies on Insecticide Residues in Chicken and Eggs and their Public Health Significance. Punjab Agricultural University, Ludhiana, India (2002).
22. S.R. Amaraneni, *J. Sci. Food Agric.*, **82**, 918 (2002).
23. U.S. Pujeri, M.I. Kumbar, A.S. Pujar, S.C. Hiremath and M.S. Yadawe, *J. Pharm. Biomed. Sci.*, 06, (2011).
24. F. Malhat and I. Nasr, *Am. J. Water Resour.*, **1**, 1 (2013).
25. R. Fagnani, V. Beloti, A. Paula, P. Battaglini, K. da S. Dunga and R. Tamanini, *Pesq. Vet. Bras.*, **31**, 598 (2011).
26. Y. Ahad, I. Hayat, I. Ahmad and M.H. Soomro, *Nucleus*, **38**, 145 (2001).
27. M. Kanda, G. Djaneye-Boundjou, K. Wala, K. Gnandi, K. Batawila, A. Sanni and K. Akpagana, *African J. Environ. Sci. Technol.*, **6**, 380 (2012).
28. O.A. Ramadan, A.A. El-Badawi Mohammad and M.A.A. Mousa, *Egypt. J. Agric. Res*., **84**, 243 (2006).
29. Z.M. Gong, S. Tao, F.L. Xu, R. Dawson, W.X. Liu, Y.H. Cui, J. Cao, X.J. Wang, W.R. Shen, W.J. Zhang, B.P. Qing and R. Sun, *Chemosphere*, **54**, 1247 (2004).
30. S. Musa, J.W. Gichuki, P.O. Raburu and C.M. Aura, *J. Ecol. Nat. Environ.*, **3**, 392 (2011).
31. B. Kumari, V.K. Madan and T.S. Kathpal, *Environ. Monit. Assess.*, **136**, 239 (2007).
32. S.P. Saxena, C. Khare, K. Murugesan, A. Farooq, T.D. Dogra and J. Chandra, *Bull. Environ. Contam. Toxicol.*, **38**, 388 (1987).
33. Y.-S. Kim, H. Eun, T. Katase and H. Fujiwara, *Chemosphere*, **67**, 456 (2007).
34. T. Nishina, C.N. Kien, N.V. Noi, H.M. Ngoc, C.-S. Kim, S. Tanaka and K. Iwasaki, *Environ. Monit. Assess.*, **169**, 285 (2010).
35. O. Prakash, M. Suar, V. Raina, C. Dogra, R. Pal and R. La, *Curr. Sci.*, **87**, 73 (2004).
36. T.S. Kathpal, R. Singh and R. Singh, *Haryana Agric. Univ. J.*, **27**, 11 (1997).
37. T. Anwar, I. Ahmad and S. Tahir, *J. Zool.*, **44**, 87 (2012).